

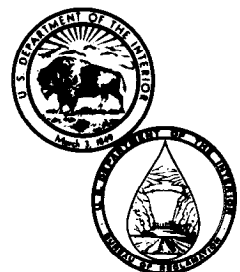
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AUTOMATED PLUGGING FACTOR MONITOR — SPECIFICATIONS

October 1983

Engineering and Research Center

**U. S. Department of the Interior
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by

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S. C. Stitt

October 1983

Power and Instrumentation Branch and
Applied Sciences Branch
Division of Research
Engineering and Research Center
Denver, Colorado



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CONTENTS

	Page
Introduction	1
PFM-EC function specifications	1
Hardware input/outputs	5
Interface to the other computer systems	5
Battery backup requirements	5
Power requirement and power supplies	5
Operator interface	5
Magnetic-tape storage	5
Environmental performance and physical requirements	5
Time accuracy	6
Software	6
Operation	6
Installation and testing	6
Maintenance documentation and training	6
Drawings, listings, and flow sheets	6
PFM-SPSBP unit function and hardware specifications	6
SPSBP flow operation	6
Relationship with total PFM system	7
Electrical power requirements	7
Compressed air requirements	7
Plumbing requirements	7
Environmental performance	7
Physical weight and dimensions	7
Fabrication and hardware specifications	7
Plan and elevation assembly drawings	7
Specifications list for purchased and fabricated components	7
Shop-fabricated parts	8
Operation	8
Purchased components specifications	8
Spare parts	8
PFM-T unit function and hardware specifications	8
The T flow operation	8
Relationship with the total PFM system	9
Electrical power requirements	9
Compressed air requirements	9
Environmental performance and physical requirements	9
Physical weight and dimensions	9
Fabrication and hardware specifications	9
Plan and elevation assembly drawing	10
Specifications list for purchased and fabricated components	10
Shop-fabricated parts	10
Operation	10
Purchased components specifications	10
Spare parts	10
Bibliography	10

CONTENTS – Continued

FIGURES

Figure

1	Front panel view of the specific, dedicated PFM-EC	1
2	Side view elevation of PFM-SPSBP	2
3	Feed water inlet plan view of the FPM-SPSBP	2
4	Front view of the FPM-T	3
5	Rear view of the PFM-T	3
6	Top view of the PFM-T	4

APPENDIX – ENGINEERING DRAWINGS

Drawing No.

1292-D-4600	Electronic controller hardware overview – system programing	13
1292-D-4601	Electronic controller operator interface	15
1292-D-4602	Electronic controller functional system flowchart	17
1292-D-4587	SPSBP and tester units schematic diagrams	19
1292-D-4588	The sample point selector booster pump, plan – front elevation	21
1292-D-4589	The sample point selector booster pump, right elevation – left elevation	23
1292-D-4590	The sample point selector booster pump, list of parts	25
1292-D-4591	The sample point selector booster pump, brackets – manifold – detail – assembly	27
1292-D-4592	The sample point selector booster pump, legs and base – supports – detail	29
1292-D-4593	Tester, plan – elevations – sections	31
1292-D-4594	Tester, list of parts	33
1292-D-4595	Rest for air cylinder – major base	35
1292-D-4596	Assembly – details	37
1292-D-4597	Details	39
1292-D-4598	Details	41
1292-D-4599	Assembly – details – sections	43

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INTRODUCTION

The quality of prefiltered feed water delivered to the membranes of an RO (reverse-osmosis), membrane-type desalting plant largely determines membrane performance and longevity. Feed-water quality can be monitored by a parameter called PF (plugging factor). PF indicates quantity of particulate matter present in feed water. In the early 1970's, a manual PF test was developed for the Government by Millipore¹ and du Pont.² Since then, this PF test has been accepted throughout the desalting industry as the criterion for determining the fouling tendency of membrane feed water. Membrane manufacturers use PF as a criterion of desalting unit feed water quality. In a plant or large test facility like the YDTF (Yuma Desalting Test Facility) Yuma, Arizona, or in the Department of the Interior OWRT (Office of Water Research and Technology) RO test facilities, each manual determination of PF required a considerable amount of operator time. To reduce workload, OWRT contracted with private industry to develop a continuous automatic system called the CPFM (continuous plugging factor monitor). The operation of a prototype unit was evaluated at YDTF in 1978. Operation of this CPFM unit was partially automatic. Each measurement required the attention of a technician to start up this unit and to calculate each PF from the data printed on a tape. The CPFM units were not completely automatic and lacked the necessary reliability and repeatability.

In February 1979, a research project was implemented at the Bureau's E&R (Engineering and Research) Center to design, fabricate, and demonstrate a totally automated PFM (plugging factor monitor) with required reliability, repeatability, and accuracy. The new monitor included an electronic controller, mechanical water sample selector, and mechanical test units. Operation of this new prototype PFM was evaluated at YDTF during 1980, which led to addition of electronic and mechanical improvements at the E&R Center. Operation of two final design PFM models were evaluated concomitantly during 1981 at the YDTF and E&R Center. The PFM assembly includes an EC (electronic controller) (fig. 1), an SPSBP (sample point selector booster pump) (figs. 2, 3), and a T (tester) (figs. 4, 5, 6). Figure 1 shows a microprocessor-based controller developed and fabricated by Bureau engineers. The controller is described in another report [1].³



Figure 1.—Front panel of the specific, dedicated PFM-EC unit.
Photo 80317

PFM-EC FUNCTION SPECIFICATIONS

Functional and hardware specifications for PFM-EC (plugging factor monitor-electronic controller) are described in this report. A PFM-EC console developed by government research engineers is described elsewhere [1]. A commercial Accurex Autodate⁴ 10/fifty process controller, or an equal of the microprocessor-based controller, can be substituted.

The PFM-EC electronically drives the PFM-T (plugging factor monitor-tester) to obtain the necessary data for calculating a plugging factor for a sample of water. Water samples can be taken from any six sources which can be selected at the SPSBP.

The process of making a measurement consists of the following basic steps:

- Measure " t_1 ," which is the amount of time it takes to pass a given volume of water through a specified filter membrane at the regulated pressure of 207 kPa (30 lb/in²).
- Continue to pass water through the filter for the specified cycle time (typically 15 minutes) while maintaining the same pressure.

¹ Millipore Corporation, Wiggins Avenue, Bedford MA 01730.

² E. I. du Pont de Nemours & Company, Inc., Glasgow Site, Wilmington DE 19898.

³ Numbers in brackets refer to the bibliography.

⁴ Accurex Corp., Autodata Division, 485 Clyde Avenue, Mt. View CA 94042.

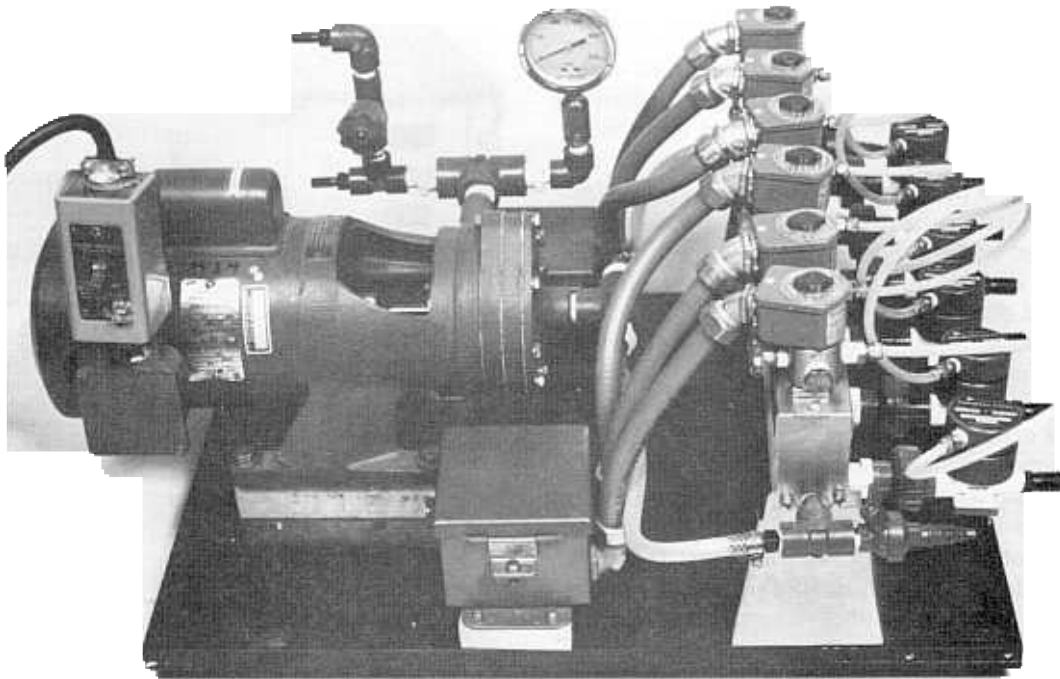


Figure 2.-Side view elevation of the PFM-SPSBP unit. Photo 80318

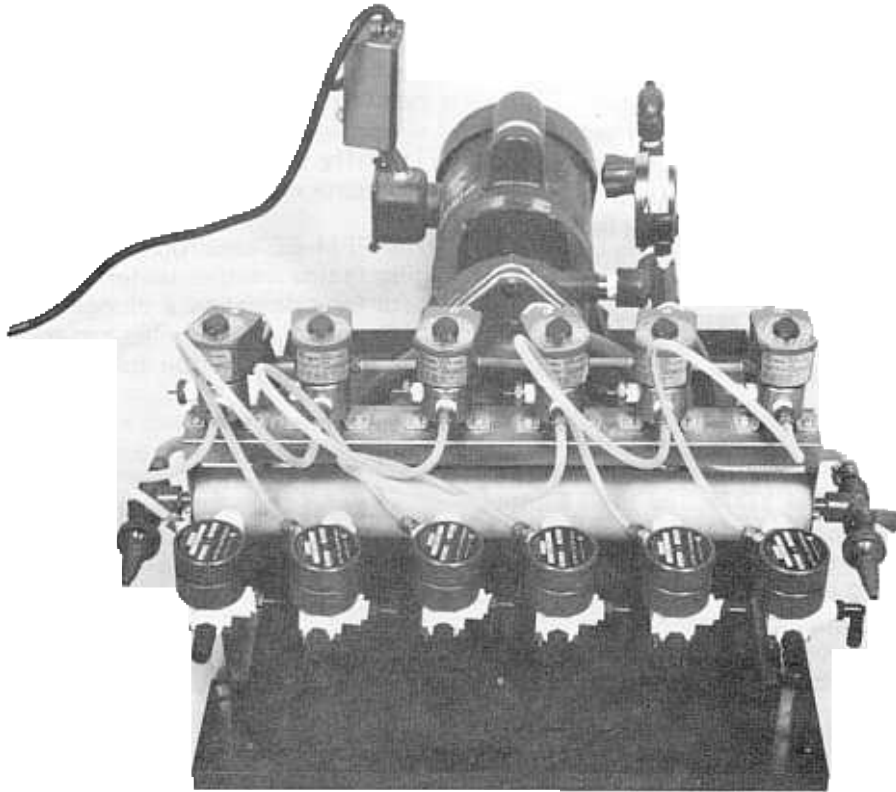


Figure 3.-Feed water inlet plan view of the PFM-SPSBP unit. Photo 80319

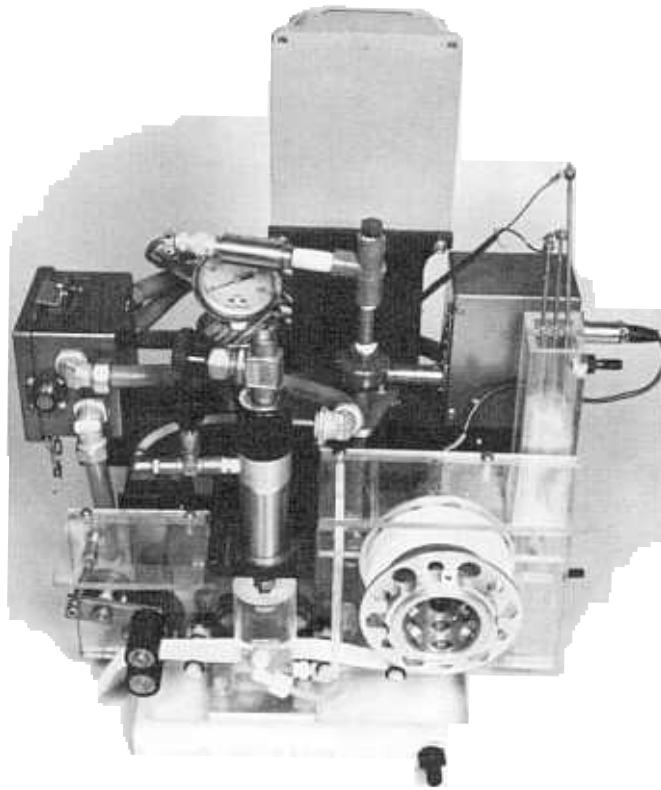


Figure 4.-Front view of the PFM-T unit. Photo 80320

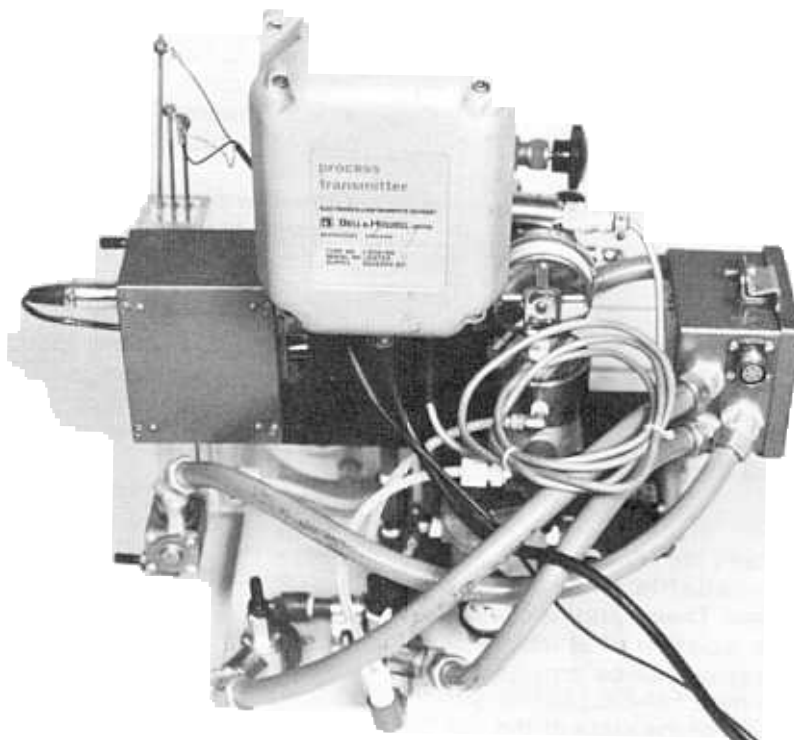


Figure 5.-Rear view of the PFM-T unit. Photo 80321

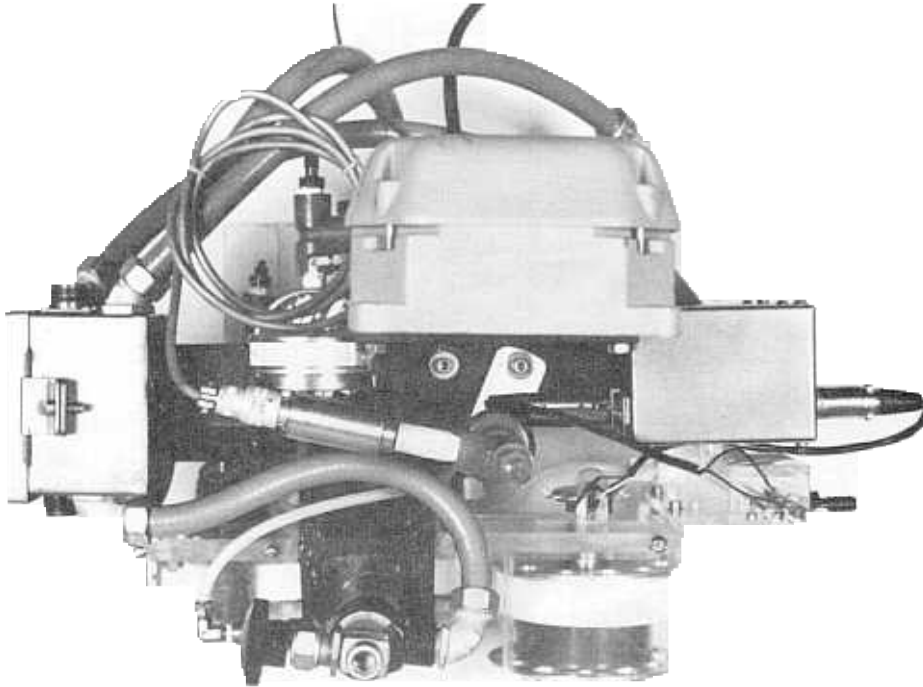


Figure 6.—Top view of the PFM-T unit. Photo 80322

Measure " t_2 " by the same conditions that " t_1 " was measured.

The PF may be calculated then by:

$$\%PF = (1 - t_1/t_2) 100.$$

PFM-EC has the following electrical requirements:

- Hardware inputs/outputs contacts
- Interface to other computer systems
- Battery backup requirements
- Power requirements and power supplies
- Operator interface
- Magnetic tape storage

Hardware Inputs/Outputs

A description of the system hardware is given (drawing 1292-D-4600).

The following types of I/O (inputs/outputs) points are required:

Contact outputs.—Fourteen are required (10 allocated and 4 spare), capable of supplying 120 V a.c. at 2.5 amperes. These outputs shall be solid-state outputs with isolation of at least plus 500 V d.c. (120-V a.c. power shall be provided by a source separate from the PFM-EC.) LED (Light-Emitting Diode) indication of the state of the output shall also be provided. If SSR (solid-state relay)

modules are provided separate from the PFM-EC, they shall be 480 mm (19 in) rack mountable and each SSR shall be a plug module for easy replacement.

Contact outputs.—Two are required (one allocated and one spare), capable of interrupting 120 V a.c. at 0.5 ampere. These outputs shall be isolated to plus or minus 500 V d.c.

Contact inputs.—Four are required (three allocated and one spare). These inputs shall be isolated to plus or minus 500 V d.c.

Analog outputs.—Eight 4-20-mA outputs required (six allocated and two spare). These outputs shall be capable of driving a 300-ohm load at 20 mA and shall have a linearity of plus or minus 1 percent. Short-circuit protection shall be provided.

Analog inputs.—Two 4-20-mA current input channels required (one allocated and one spare) shall have a maximum input impedance of 250 ohms.

A summary of the I/O point functions is as follows:

Interface to the SPSBP

- Six voltage-supplied contact outputs to drive the stream select valves

Interface to the CFM-T

- Four voltage-supplied contact outputs
 1. One to divert water from CFM-T to drain.
 2. One for the air pressure head.
 3. One to drive the millipore tape feed motor.
 4. One to drain the filtrate tank.
- Three logic level inputs, one each for:
 - high-water-level sensor
 - low-water-level sensor
 - paper fault sensor
- One analog input from the water-pressure transducer

Interface to other data acquisition equipment

- Six analog outputs for external monitoring of the six plug factor measurements

Interface to a remote annunciator

- One voltage-isolated contact output

Spare I/O points

- Four voltage-supplied contact outputs
 - One logic level input
 - Two analog current outputs
 - One analog current input
 - One voltage isolated contact output

Interface to the Other Computer Systems

The capability to provide an RS232 interface to a central computer system for communicating plug factor measurements shall be provided. The present software will not be required to perform this interface, but future use of this serial link should be possible.

The ability to monitor and operate the system remotely using a standard RS232 compatible terminal should be provided for future use.

Battery Backup Requirements

The PFM-EC shall have nonvolatile memory or solid-state battery, backed-up memory for maintaining

system status throughout a power failure. If a battery is provided, the system should be capable of maintaining memory for a minimum of 48 hours without power. The PFM-EC should be capable of operation throughout a power failure without operator action, during which modification of the following quantities should be maintained by the system:

- The six plugging factor measurements
- The current stream being sampled (on power up, the PFM-EC should begin sampling at the stream which was selected when the power failed)
- The status of the six selected water sample points (whether these streams are active or inactive)
- The logger status (on or off)
- The t_1 limit
- The t_2 limit
- Plug factor limit
- Cycle time

Power Requirement and Power Supplies

The PFM-EC shall operate on 120 V a.c., and power consumption shall not be more than 300 watts. Breaker or fuse protection shall be provided. All internal power supplies shall have short-circuit and over-voltage protection.

Operator Interface

The operator interface shall be accomplished with an interactive CRT display format (drawing D-4601). The screen shall be capable of flashing alarm quantities, highlighting status quantities, and providing inverse video to indicate the quantities to be changed by the operator. Operator input shall be provided in such a way as not to interrupt the process control system. An alphanumeric printer shall be provided which can print a record of all samples and all alarms that occur. An audible alarm shall be provided for local annunciation of alarms.

Magnetic Tape Storage

A cassette tape drive shall be provided for backup storage of the source program. The tape will not be required for normal operation of the unit but will be used only in backup situations if a memory failure occurs.

Environmental Performance and Physical Requirements

The PFM-EC shall be capable of operating in an industrial environment without air conditioning available. The operating temperature range shall be from

0 to 50 °C (122 °F) ambient air temperature with a humidity range from 0 to 90 percent.

Time Accuracy

The PFM-EC must be capable of making the time measurements of t_1 and t_2 with an accuracy of plus 0.1 second.

Software

The system software package for the PFM-EC shall operate to perform the plugging factor measurements shown (drawing D-4602) in the functional system flow chart. The software must also provide the operator interface features indicated (drawing D-4601) in previous paragraphs. The system should operate in a loop, taking measurements on selected active streams, updating the front panel display, and logging measurement records if required. System software for the Accurex Autodata 10/fifty process controller has been formulated and tested. Flow charts and listings of that software will be made available following award of contract.

Operation

An operations manual of the PFM-EC system shall be provided, together with operation manuals provided by the controller manufacturer. A training session for plant personnel shall be provided. The operator shall be required only to perform initial settings of the system. Further operator attention shall be required only in case of alarms or paper records retrieval.

Installation and Testing

The system shall be installed and all hardware inputs and outputs shall be tested individually. Procedures for performing these tests shall be documented for future use by plant maintenance personnel. Calibration of the analog input and output quantities shall be performed.

The installation of the PFM-EC shall be performed in such a way as to allow plant maintenance personnel to replace the unit by unplugging the various interface connections. Disconnection of terminal strip lugs shall not be required for unit replacement. All plug connections shall be keyed or varied such that incorrect installation is not possible.

Maintenance Documentation and Training

Methods for individual testing of each interface device or input/output port shall be documented for

use by plant personnel. Easy measurement of system power supplies through external jacks shall be provided.

Software maintenance shall be provided such that the plant maintenance engineer may be capable of tracing program functions. The system should allow for breakpoints to any program statement. If program changes are required, the system will allow changes to be made at that location.

A formal training session together with complete manuals concerning both hardware and software maintenance shall be provided for plant maintenance personnel.

Drawings, Listings, and Flow Sheets

Hardware drawings, software listings, and software flow charts shall be made available for review before installation of the first PFM-EC.

PFM-SPSBP UNIT FUNCTION AND HARDWARE SPECIFICATIONS

The PFM-SPSBP draws continuous flow samples of test water from one to six preselected sources. Each sample of water is pumped to the PFM-T at a back-controlled pressure of 207 kPa for the duration of the time required (20 min) to determine the percent PF of each sample.

SPSBP Flow Operation

The schematic flow diagram for the SPSBP unit is shown on drawing 1292-D-4587 which includes the following nomenclature.

The unit operates as follows:

Before establishing the operation of the SPSBP unit under the control of the PFM-EC, the pump is deactivated by the following procedure:

Manually open valve V1 to permit the flow of water into the manifold through the pump P1 and to the PFM-T.

Switch on the pump.

Continue flow of water through the unit until all entrapped air is cleared or until pressure gage PI-1 reaches a steady state of about 207 kPa (30 lb/in²).

Activate automatic water-sample selection with the PFM-EC.

For example, test water will be diverted from position S₁ by energizing solenoid air valve A which, in turn, opens diverter valve A (when valve A opens for the first time, close manual valve V1 and leave closed).

Water will continue to flow from position S₁ to the PFM-T until the PFM-EC sends a signal to deenergize solenoid valve A. (Actually, the next position will be energized a few seconds before deenergizing position S₁).

The PFM-EC will energize another preselected position. For example: At sample point S4, "solenoid valve" D is energized by the EC and releases air from the manifold to open "diverter valve" D.

Relationship With Total PFM System

The pump on the SPSBP unit is operated by a 120-V, a-c, off-on manual switch. The EC unit is interfaced to the SPSBP unit by six wet contact outputs to drive stream select valves A, B, C, D, and E. The only connection between the pump unit and the PFM-T unit is by 8-mm i.d. by 3.2-mm-thick (5/16- by 1/8-in) reinforced vinyl tubing. This interconnecting tubing will permit the test water to flow from the pump into the T unit.

Electrical Power Requirements

The only electric power requirement for the operation of the SPSBP unit is to provide for plug-in of the pump to a 120-V, a-c, 30-ampere outlet circuit. The pump unit should be provided with a manual on-off switch with reset and a neon indicating light and 2400 mm (8 ft) of 16/3-type, SO, oil-resistance conductor with a three-prong plug. Power requirements for the six stream select valves are specified in the PFM-EC section of this report.

Compressed Air Requirements

Plant compressed air should be regulated to provide air at 360 to 400 kPa (52 to 58 lb/in²) pressure to the three-way diverter valves A, B, C, D, E, and F by a suitable hose and connections.

Plumbing Requirements

Water should be supplied at normal city water pressure through an 8-mm i.d. by 3.2-mm-thick (5/16- by 1/8-in) reinforced vinyl tubing to the pump decavitation valve V-1. The tube should be secured at either end with an SS screw-type hose clamp.

Environmental Performance

The PFM-SPSBP unit shall be capable of operating in an industrial environment without air conditioning available. The operating temperature range shall be from 0 to 50 °C (122 °F) ambient temperature, with a humidity range from 0 to 90 percent.

Physical Weight and Dimensions

Unit PFM-SPSBP is about 40 kg (88 lb) and allows for protrusion of tubing and wire conductors. It has a maximum three-dimensional volume of 610 mm width, 814 mm depth, and 410 mm height (24- by 32- by 16-in).

Fabrication and Hardware Specifications

Components are to be fabricated, purchased, and assembled according to the following Bureau enclosed drawings for the SPSBP unit:

- Drawing 1292-D-4588, Plan – Front Elevation
- Drawing 1292-D-4589, Right Elevation – Left Elevation
- Drawing 1292-D-4590, List of Parts
- Drawing 1292-D-4591, Brackets – Manifold – Detail – Assembly
- Drawing 1292-D-4592, The Legs and Base – Supports – Detail

Plan and Elevation Assembly Drawings

Drawings 1292-D-4588 and D-4589 show plan, front elevation, operational side elevation, and motor side elevation of the assembled SPSBP unit. Purchased components and shop-fabricated components are identified by part number. Generally, only one of each type of part is numbered. Components are identified by parts 101 through 141. Reference to the four assembly views should permit the Contractor to assemble the SPSBP unit.

Specifications List for Purchased and Fabricated Components

Drawing 1292-D-4590 is a specifications list for all the part numbers identified on drawings D-4588 and D-4589. The part numbers are listed in the first column. The number of each part required to complete one assembly of the SPSBP unit is listed in the second column. All parts are specified in the description column. Sufficient data are given on each part requiring purchase. Other vendor parts can be substituted provided all the specifications given in the

description column are met. Parts requiring shop fabrication are referred to by part numbers and drawing numbers. The material of construction is listed in the last column. Substitutions should not be made for materials of construction.

Shop-Fabricated Parts

Drawings 1292-D-4591 and D-4592 are shop fabrication drawings for parts 103, 112, 116, 129, 132, 133, 134, and 135. Under the direction of the project engineer, the original dimensions made by the machinist that fabricated the parts for the Government's prototype SPSBP unit, and the drawings were made by an experienced drafting technician; therefore, they can be used directly for this purpose of a fabrication shop.

Operation

Operation of the EC unit has been specified in the PFM-EC section of this report. The EC unit is the electronic operator for the SPSBP unit.

Purchased Components Specifications

The Contractor shall provide a service manual for the purchased components used. The service manual should contain copies of the purchase requisitions, vendor catalog sheets, parts list, and vendor's maintenance sheets for each type of purchased item. The manual should be subdivided with tabs showing part numbers given in drawing 1292-D-4590.

Spare Parts

The Contractor shall provide the following spare parts as described on drawing 1292-D-4590:

Part (as shown on drawing 1292- D-4590)	Number of spares required
101	6
102	6
115	2
126	2
131	2
137	1
144	2

In addition, the Contractor shall furnish the following parts for part 137, multistage centrifugal pump, Eastern model 2F-3D, or equal, as manufactured by Eastern Pump Division, LFE Corp., Hamden, Conn.

Description	Number required
Bushing assembly A-12688-SMO	3
Body gasket – Teflon S-16814	6
Chamber gasket – Teflon A-16813	6
Seal, HD, rotary-tabulation drawing A-307307-3-(C)	3
Seal, stop, C-307029-SMO	3
Gasket, Teflon B-307034-2	6
3-1/8-inch impeller, part 307-947-1-SMO for 2F-34D	2

PFM-T UNIT FUNCTION AND HARDWARE SPECIFICATIONS

The PFM-T (plugging factor monitor-tester) unit accepts subsequent continuous flow samples of test water from the SPSBP unit. Water flow through the tester is controlled by the PFM-EC system by diverting at a pressure of 207 kPa (30 lb/in²) through a membrane filter into a measuring tank and then to a waste drain.

The T Flow Operation

A schematic flow diagram for the T unit is given (drawing D-4587) and it operates as follows:

1. The water to be sampled flows into the tester at slightly higher than 207-kPa pressure for the SPSBP unit.
2. Sample water pressure is held constant at 207 kPa by the air-pressure-controlled back pressure diverter (PBV-1) which relieves overpressure by diverting part of the water flow to the drain.
3. When the main-flow, three-way solenoid valve (3WV-1) is not energized, all of the flow is diverted to the drain and the tester is in "test-off" condition.
4. At the beginning of each test, the paper drive motor (M1) is energized to advance the membrane tape about 40 mm (1.575 in) through the open filter heads. [The filter area is 345 mm² (0.535 in²).]
5. The electric- and air-operated piston (SVP-1) is energized to compress the filter paper between the filter holder head and base.

6. When the three-way solenoid valve (3WV-1) is energized ("test-on" condition), the flow to the drain is shut off and all flow is diverted through the back pressure diverter to the filter holder head.

7. Sample water flows through the filter paper and enters the measuring collector tank (TK-1) and flows to the drain through the normally open test-drain solenoid control valve (2WV-1).

8. The test starts when the test-drain solenoid control valve (2WV-1) is energized, which closes the drain and allows the tank to begin filling.

9. Time starts when the liquid level reaches the start electrode and stops when it reaches the stop electrode and then solenoid valve (2WV-1) is deenergized to open. The upper and lower electrodes are preset for measuring 131 mL of water. The first measurement is t_1 .

10. With the valve opened, the tank is drained and the sample stream of water continues to flow through the membrane for 15 minutes into the drain.

11. After 15 minutes, the solenoid valve (2WV-1) is again closed, and again the volumetric reading is made to determine t_2 . The feed valve (3WV-1) is then deenergized and the test is over.

Relationship With the Total PFM System

The electrical power is supplied to the T unit through the EC unit and is interfaced by:

Four wet contact outputs:

- One to divert water from CFM-T to drain (3WV-1)
- One for the electric air-powered operator (SVP-1)
- One to drive the paper-feed drive motor (M-1)
- One to drain the filtrate tank (2WV-1)

Three logic level inputs:

- One for the high-water-level sensor (stop electrode)
- One for the low-water-level sensor (start electrode)
- One for the paper fault detector

One analog input from water-pressure transducer.

The only connection between the pump unit and the T unit is by an 8-mm i.d. by 3.2-mm-thick (5/16- by 1/8-in) reinforced vinyl tubing. This interconnecting hose permits the test water to flow from the pump into the T unit. The tubing should be secured at both ends by screw-type hose clamps.

Electrical Power Requirements

Power requirements for operation of the PFM-T unit are specified in the PFM-EC section of this report.

Compressed Air Requirements

Compressed air from a 0- to 414-kPa (60- lb/in²) regulator should be connected to supply the air regulator valve (AR-1), the back-pressure diverter valve (PBV-1), and the electric air-powered operator (SVP-1) by a suitable hose and connections.

Environmental Performance and Physical Requirements

The PFM-T unit shall be capable of operating in an industrial environment without air conditioning available. The operating temperature range shall be from 0 to 50 °C (122 °F) ambient temperature with a humidity range 0 to 90 percent.

Physical Weight and Dimensions

Unit PFM-T is 22 kg (48 lb) and allows for protrusion of tubing and wire conductors. It has a maximum three-dimensional volume of 560-mm width, 560-mm depth, and 660 mm height (22- by 22- by 26-in).

Fabrication and Hardware Specifications

Components are to be fabricated, purchased, and assembled according to the following Bureau of Reclamation drawings for the T unit:

- Drawing 1292-D-4593, Tester, Plan – Elevations – Sections
- Drawing 1292-D-4594, List of Parts
- Drawing 1292-D-4595, Rest for Air Cylinder – Major Base
- Drawing 1292-D-4596, Assembly – Details, Housing and Roll Arm
- Drawing 1292-D-4597, Details
- Drawing 1292-D-4598, Details, Pivot, And Shields
- Drawing 1292-D-4599, Assembly – Details – Sections

Plan and Elevation Assembly Drawing

Drawing 1292-D-4593 shows plan, front elevation, and right side elevation of the assembled T unit. Purchased components and shop-fabrication components are identified by a part number. Generally, only one of each type of part is numbered. Components are identified by parts 1 through 66. Reference to drawing 1292-D-4593 should permit the Contractor to assemble the T unit.

Specifications List for Purchased and Fabricated Components

Drawing 1292-D-4594 is a specifications list for all the part numbers identified on drawing D-4593. The part numbers are listed in the first column. The number of each part required to complete one assembly of the T unit is listed in the second column. All parts are specified in the description column. Sufficient data are given on each part requiring purchase. Other vendor parts can be substituted provided all the specifications given in the description column are met. Parts requiring shop fabrication are referred to by drawing numbers. The material of construction is listed in the last column. Substitutions should not be made for materials of construction.

Shop Fabricated Parts

Drawings 1292-D-4595, D-4596, D-4597, D-4598, and D-4599 are shop fabrication drawings for parts 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 20, 33, 59, 60, 61, 63, and 64. These drawings were developed by the machinist that fabricated the parts for the Government prototype T unit and they can be used directly for this purpose by a fabrication shop.

Operation

Operation of the PFM-EC system has been specified in the PFM-EC section of this report. The EC system is the electronic operator for the T unit.

Purchased Components Specifications

The Contractor will provide a service manual for the purchased components used to build each T unit. The service manual should contain copies of the purchase requisitions, vendor catalog sheets, parts list, and vendor's maintenance sheets for each type of

purchased item. The manual should be subdivided with tabs showing part number given in drawing 1292-D-4594.

Spare Parts

The Contractor shall provide the following spare parts as described in drawing 1292-D-4594:

Part (as shown on drawing 1292- D-4594)	Number of spares required
10	2
21	40
23	2
24	2
25	2
26	3
27	2
28	2
29	6
30	6
31	6
32	12
34	12
37	3
39	12
47	2
51	12
52	12
53	2
54	3
59	4
65	1
66	4

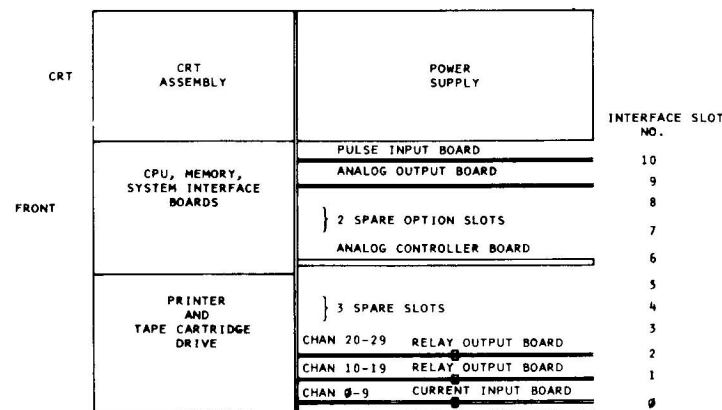
BIBLIOGRAPHY

- [1] Stitt, S. C., C. A. Loeser, J. M. Hodgson, and G. Brown, "A Microprocessor-Based Controller for the Plugging Factor Monitor," Report No. REC-ERC-81-14, 211 pp., Bureau of Reclamation, Denver, Colorado, May 1981.
- [2] Eisenhauer, R. J. and G. C. Goodner, "Development of an Automated Plugging Factor Monitor," Report No. REC-ERC-81-12, 13 pp., Bureau of Reclamation, Denver, Colorado, December 1981.

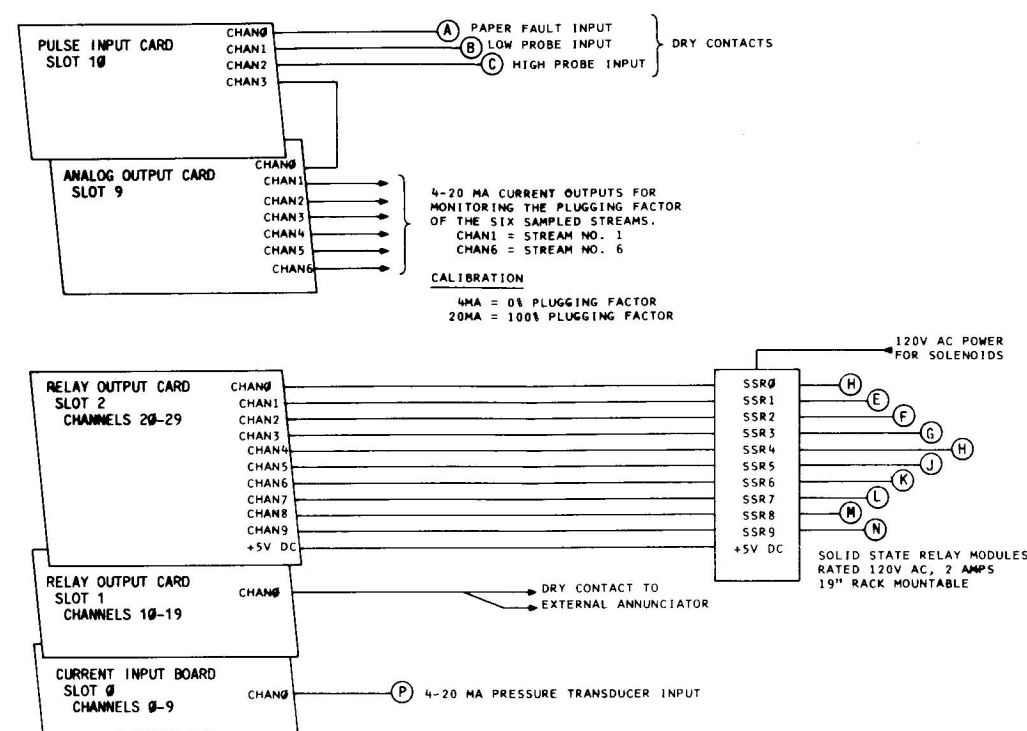
APPENDIX – ENGINEERING DRAWINGS

PLUGGING FACTOR MONITOR HARDWARE OVERVIEW

AUTODATA 10/50 TOP VIEW - CONFIGURATION



SYSTEM INTERFACE



SYSTEM PROGRAMMING

CHANNEL PROGRAMMING TABLE (PERFORMED ON PAGE 5)

CHANNEL NO.	ENGR. UNITS (E/U)	ASN (ASSIGN BLOCK)	NOTES	HARDWARE LOCATION
0	18	---	ASSIGN E/U 18 - E/U 43 SET M = 3.52 B = 0.0 (ON PAGE 10)	SLOT 0, CHAN 0
10	39	CON(C300,C300,1,1)		SLOT CHAN 0
20-29	39	CON(C300,C300,1,1)		SLOT 2, CHAN 0-9
300	46	II(1,0)	SET LIMIT NO. 1 MESSAGE = "7" (DISABLE ALARM SYSTEM)	SEUDO CHANNEL
500	47	DIG(5,0,2,DUM,1,1)	CARD 5, CHAN 0 (DRY CONTACT INPUT)	SLOT 10, CHAN 0
501	47	DIG(5,1,2,DUM,1,1)	CARD 5, CHAN 1 (DRY CONTACT INPUT)	SLOT 10, CHAN 1
502	47	DIG(5,2,2,DUM,1,1)	CARD 5, CHAN 2 (DRY CONTACT INPUT)	SLOT 10, CHAN 2
503	47	DIG(5,3,1,DUM,1,1)	CARD 5, CHAN 3 (PERIOD MEASUREMENT)	SLOT 10, CHAN 3
800	46	TT(0.)	CLOCK INPUT CHANNEL	SEUDO CHANNEL

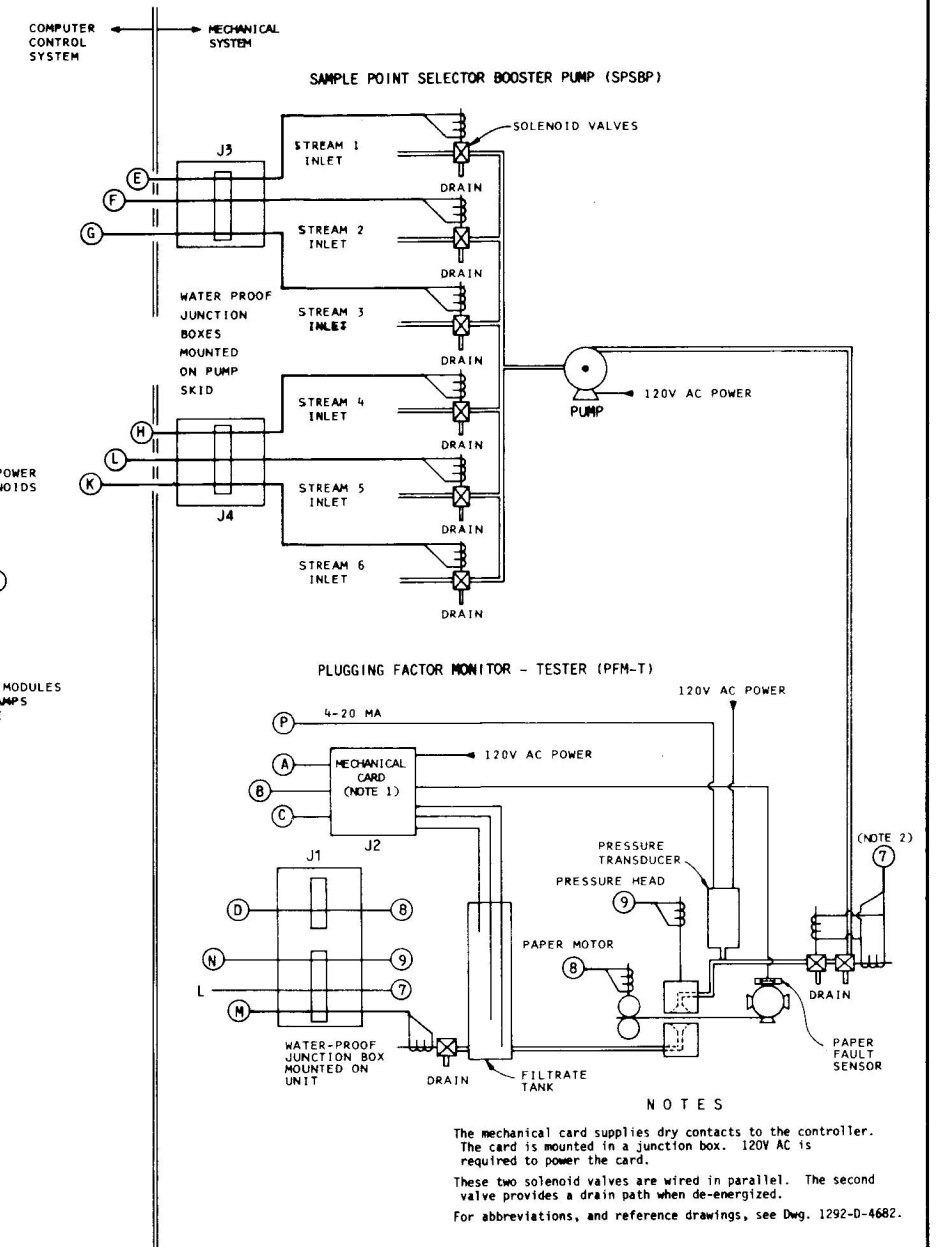
EXPRESSION PROGRAMMING (ON PAGE 16)

NAME	ALGEBRAIC/ LOGICAL	DEFINITION
II	A	A (VARIABLE A)
TT	A	TIM(A) (TIME FUNCTION)

SCAN PROGRAMMING (ON PAGE 6)

SCAN NO.	FIRST/LAST	INTERNAL
1	000/000	00:00:04 (EVERY 4 SECONDS)

SCAN CHAN 0, PRESSURE INPUT, EVERY 4 SECONDS



NOTES

The mechanical card supplies dry contacts to the controller. The card is mounted in a junction box. 120V AC is required to power the card.
These two solenoid valves are wired in parallel. The second valve provides a drain path when de-energized.
For abbreviations, and reference drawings, see Dwg. 1292-D-4682.

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COLORADO RIVER BASIN SALINITY CONTROL PROJECT
TITLE I DIVISION - DESALTING COMPLEX UNIT - ARIZONA
YUMA DESALTING PLANT
PLUGGING FACTOR MONITOR
ELECTRONIC CONTROLLER
HARDWARE OVERVIEW - SYSTEM PROGRAMMING

DESIGNED: *[Signature]* TECHNICAL APPROVAL: *[Signature]*
DRAWN: *[Signature]* SUBMITTED: *[Signature]*
CHECKED: *[Signature]* APPROVED: *[Signature]*
CHIEF, POWER AND INSTRUMENTATION BRANCH
DENVER, COLORADO FEB. 28, 1983 1292-D-4600

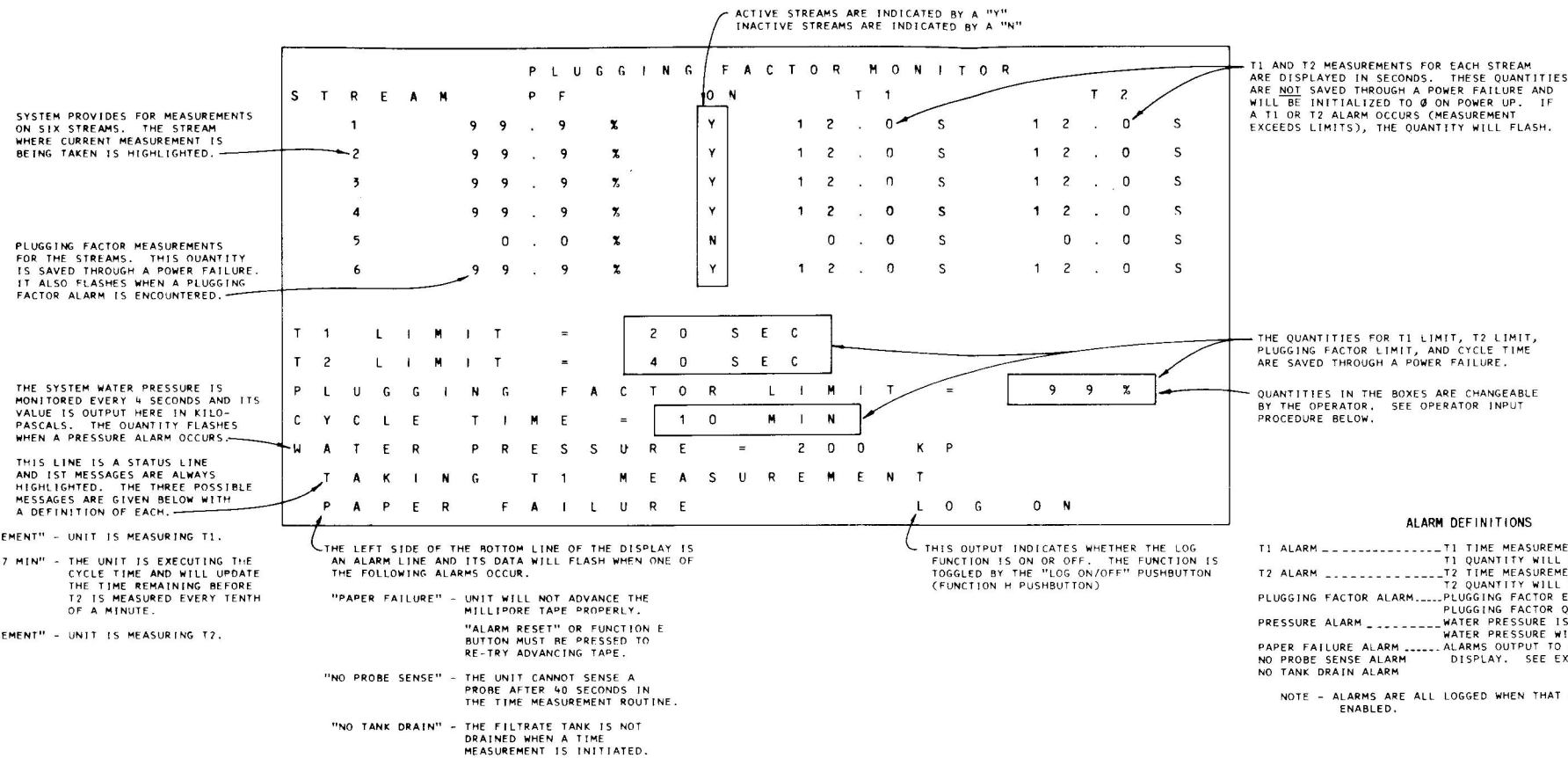
OPERATOR INTERFACE (AUTODATA 10/50 PAGE 34)

ABBREVIATIONS

T1 Time one
T2 Time two
SPSBP Sample point selector booster pump
T Tester
PF Plugging factor
PFM Plugging factor monitor
PWR Power
EC Electronic controller
GND Ground
CN Connector
CRT Cathode ray tube
SSR Solid state relay
PMSM Programmable master supervisory computer

REFERENCE DRAWINGS

SAMPLE POINT SELECTOR BOOSTER PUMP,
PLAN - FRONT ELEVATION 1292-D-4588
TESTER, REST FOR AIR CYLINDER - 1292-D-4595
MAJOR BASE 1292-D-4587
SCHEMATIC DIAGRAMS 1292-D-4587



ALARM DEFINITIONS

T1 ALARM - T1 TIME MEASUREMENT EXCEEDED LIMIT.
T2 ALARM - T2 TIME MEASUREMENT EXCEEDED LIMIT.
PLUGGING FACTOR ALARM - PLUGGING FACTOR EXCEEDED LIMIT.
PRESSURE ALARM - PLUGGING FACTOR QUANTITY WILL FLASH.
PAPER FAILURE ALARM - PLUGGING FACTOR QUANTITY WILL FLASH.
NO PROBE SENSE ALARM - WATER PRESSURE IS NOT WITHIN LIMITS.
NO TANK DRAIN ALARM - WATER PRESSURE WILL FLASH.

NOTE - ALARMS ARE ALL LOGGED WHEN THAT FUNCTION IS ENABLED.

QUANTITIES WHICH ARE SAVED THROUGH POWER FAILURE

1. THE STREAM COUNT OR THE COUNT (1 THRU 6) OF WHICH STREAM IS BEING SAMPLED. ON POWER UP, THE UNIT WILL BEGIN SAMPLING AT THAT STREAM.
2. THE PLUGGING FACTOR MEASUREMENTS FOR THE SIX STREAMS.
3. THE ACTIVE STATUS OF THE SIX STREAMS.
4. T1 LIMIT, T2 LIMIT, PLUGGING FACTOR LIMIT, AND CYCLE TIME.
5. THE LOGGER STATUS

POWER UP PROCEDURE

1. GO TO PAGE 4 OF THE AUTODATA 10/50 SYSTEM AND SET THE PROPER DATE AND TIME.
2. RETURN THE DISPLAY TO PAGE 34 OF THE AUTODATA 10/50 SYSTEM.

OPERATOR INPUT PROCEDURES

THE FOLLOWING FUNCTION BUTTONS HAVE THE GIVEN MODES OF OPERATION

- "CURSOR" (FUNCTION A) - THIS BUTTON ROTATES AN INVERSE VIDEO CURSOR THROUGH 10 POSITIONS WHICH CORRESPOND TO THE TEN QUANTITIES BOXED IN ON THE ABOVE FORMAT DRAWING. AN 11TH POSITION ALLOWS THIS CURSOR TO BE OFF. THE CURSOR MUST FIRST BE POSITIONED ON A QUANTITY BEFORE IT CAN BE CHANGED.
- "Y OR N OR UNITS" (FUNCTION B) - PRESSING THIS BUTTON WHILE THE CURSOR IS ON THE ACTIVITY STATUS FOR A STREAM CAUSES THE STATUS TO TOGGLE. IF THE CURSOR IS OVER A NUMBER QUANTITY, THE UNITS DIGIT WILL INCREASE BY 1 OR GO FROM 9 TO 0.
- "TENS DIGIT" (FUNCTION C) - PRESSING THIS BUTTON CAUSES THE TENS DIGIT OF NUMBER QUANTITY TO INCREASE BY 1 OR ROLL OVER FROM THE LIMIT TO 0. THIS OCCURS ONLY WHEN THE CURSOR IS POSITIONED TO THAT QUANTITY.
- "CLEAR ALARMS" (FUNCTION E) - PRESSING THIS BUTTON CAUSES ALL ALARM INDICATIONS TO RESET AND IN THE CASE OF A PAPER FAILURE ALARM CAUSES THE PAPER ADVANCE TO BE PERFORMED AGAIN.
- "LOGGER ON/OFF" (FUNCTION H) - PRESSING THIS BUTTON CAUSES THE LOG STATUS TO TOGGLE.

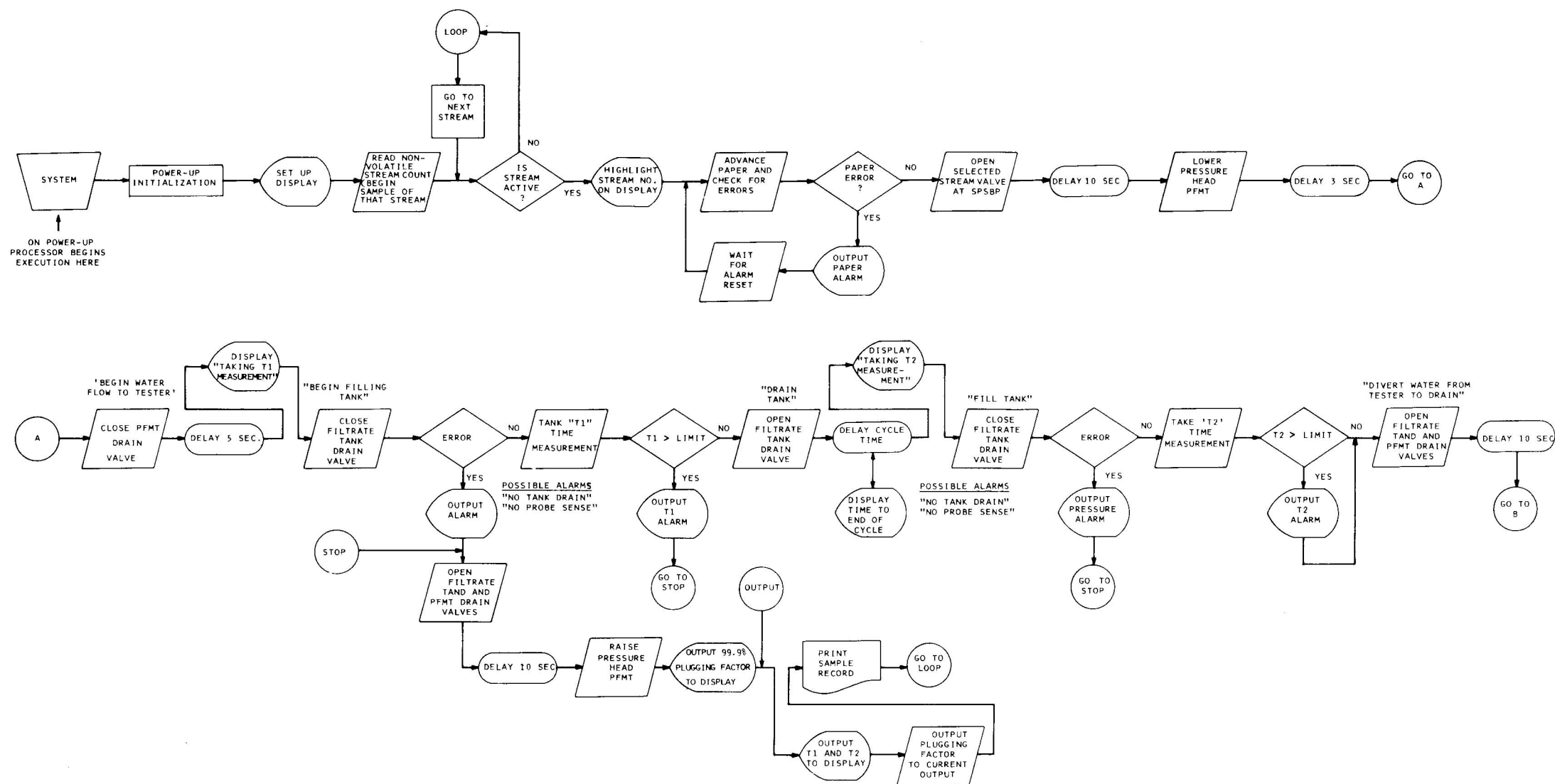
RANGE OF INPUT VALUES

T1 LIMIT - 0 TO 59
T2 LIMIT - 0 TO 59
PLUGGING FACTOR LIMIT - 0 TO 99
CYCLE TIME - 0 TO 99

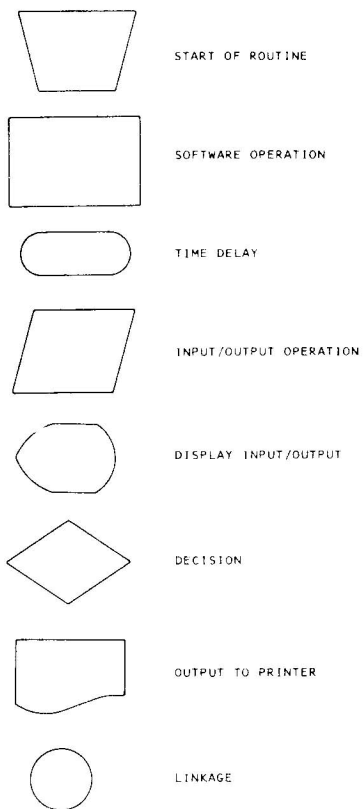
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TITLE 1 DIVISION - DESALTING COMPLEX UNIT - ARIZONA
YUMA DESALTING PLANT
PLUGGING FACTOR MONITOR
ELECTRONIC CONTROLLER
OPERATOR INTERFACE

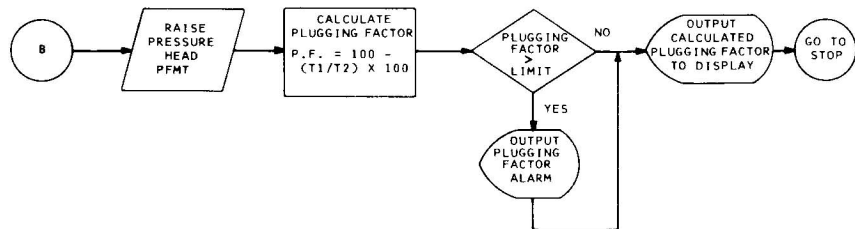
DESIGNED: *[Signature]* TECHNICAL APPROVAL: *[Signature]*
DRAWN: *[Signature]* SUBMITTED: *[Signature]*
CHECKED: *[Signature]* APPROVED: *[Signature]*
CHIEF, POWER & INSTRUMENTATION BRANCH
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FLOWCHART SYMBOLS



NOTE
For abbreviations and reference drawings, see drawing 1292-D-4601



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DESIGNED: <i>[Signature]</i>	TECHNICAL APPROVAL: <i>[Signature]</i>
DRAWN: <i>[Signature]</i>	SUBMITTED: <i>[Signature]</i>
CHECKED: <i>[Signature]</i>	APPROVED: <i>[Signature]</i>
DENVER, COLORADO	FEB 28, 1983 1292 - D - 4602

DEVICE DESIGNATION NUMBER	PROCESS & INSTRUMENTATION DIAGRAM	INSTALLATION DRAWING	NUMBER	COMMENTS
PF-04-0Δ701	1292-D-4658	1292-D-4673	7	Δ is 1,2,3,4,5, 6, or 7
PF-1 6-03701	1292-D-4661	1292-D-4656	1	
PF-1 6-03702	1292-D-4661	1292-D-4656	1	
PF-06-01701	1292-D-4659	1292-D-4648	1	
PF-06-01702	1292-D-4659	1292-D-4648	1	
PF-1 6-05701	1292-D-4662	1292-D-4656	1	
PF-1 6-07301	1292-D-4142	1292-D-4523	1	Hydraulics
PF-1 6-08301	1292-D-4143	1292-D-4523	1	Fluid Systems
PF-07-00501	1292-D-4728 1292-D-4731	1292-D-4581	1	
Spares	—	—	2	Assembled

Each plugging factor monitor has an associated DDN as defined on drawing number 1292-D-1884.

V	Valve
CV	Check valve
P	Padding air source
PI	Pressure indicator
PFM	Plugging factor monitor.
SPSBP	Sample point selector booster pump.
3WV	Three way valve.
2WV	Two way valve.
PBV	Back pressure diverter.
PT	Pressure transmitter.
PE	Pressure element
AR	Air regulator
SVP	Electric & air operated piston
MI	Motor.
TK	Tank.
PI	Pump.
S	Sample source

SAMPLE POINT SELECTOR BOOSTER PUMP PLAN AND ELEVATION	1292-D-4587
TESTER PLAN, ELEVATIONS, AND SECTIONS	1292-D-4593
ELECTRONIC CONTROLLER HARDWARE OVERVIEW	1292-D-4600

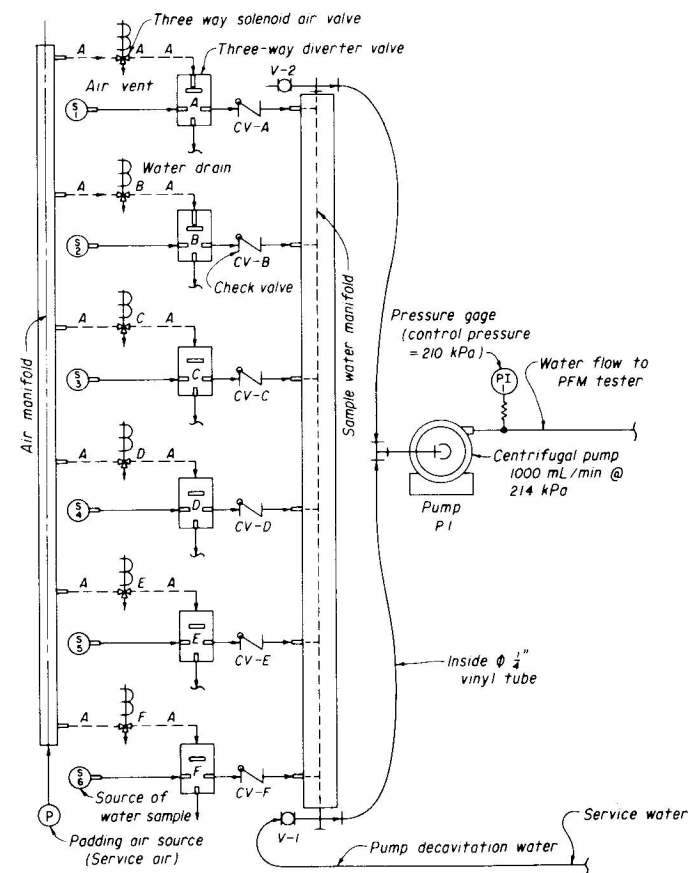


FIGURE 1
SCHEMATIC DIAGRAM FOR THE SPSBP UNIT
NOT TO SCALE

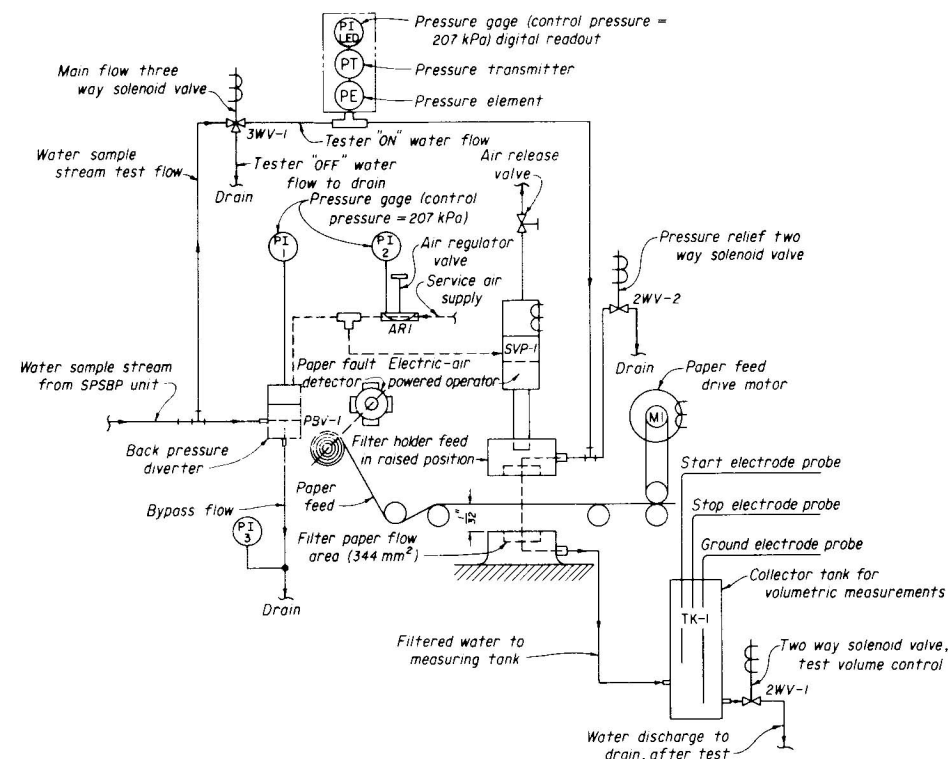


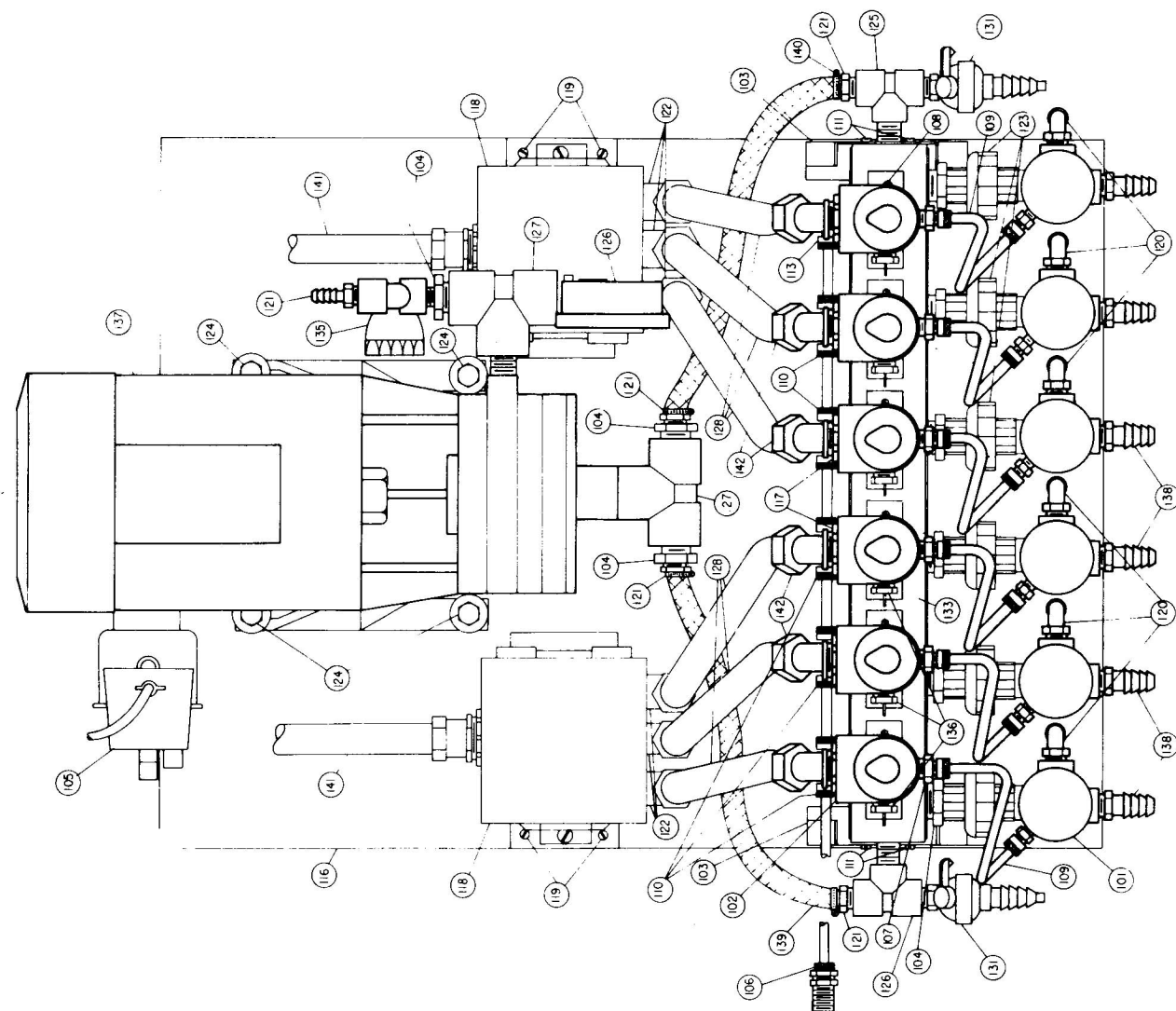
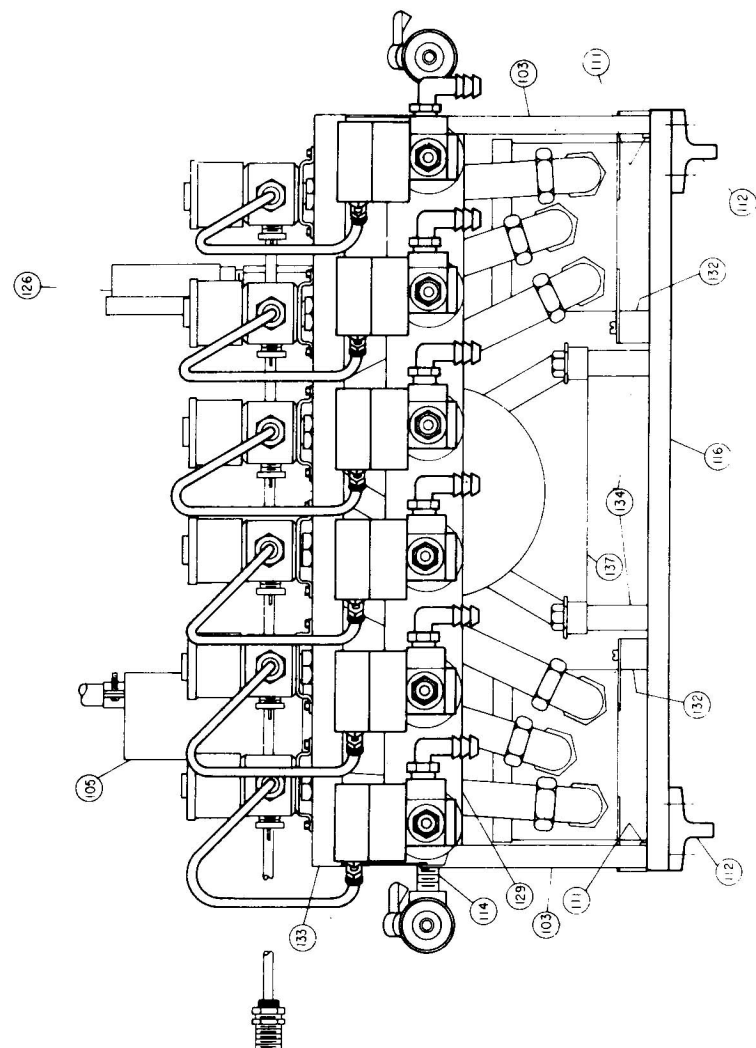


FIGURE 2
SCHEMATIC DIAGRAM FOR
THE PLUGGING FACTOR MONITOR TESTER UNIT
NOT TO SCALE

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COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION-YUMA DESALTING COMPLEX-ARIZONA		
YUMA DESALTING PLANT PLUGGING FACTOR MONITOR SPS&P AND TESTER UNITS SCHEMATIC DIAGRAMS		
DESIGNED BY <u>W. E. B. Smith</u>	TECHNICAL APPROVAL BY <u>W. E. B. Smith</u>	
DRAWN BY <u>W. E. B. Smith</u>	SUBMITTED BY <u>W. E. B. Smith</u>	
CHECKED BY <u>W. E. B. Smith</u>	APPROVED BY <u>W. E. B. Smith</u>	
CHIEF APPLIED SCIENCES BRANCH		
DENVER, COLORADO	FEB 8, 1983	1292-D-4587



PLAN
NOT TO SCALE



FRONT ELEVATION
NOT TO SCALE

GENERAL NOTES

For finished overall dimensions see the specifications paragraphs.
Part numbers are denoted as (118) and are identified on
Dwg. 1292-D-4590.
Dimensions are in millimeters unless otherwise shown.

REFERENCE DRAWINGS

TESTER, PLAN, ELEVATIONS AND SECTIONS. 1292-D-4593
SCHEMATIC DIAGRAMS. 1292-D-4587
HARDWARE OVERVIEW. 1292-D-4600

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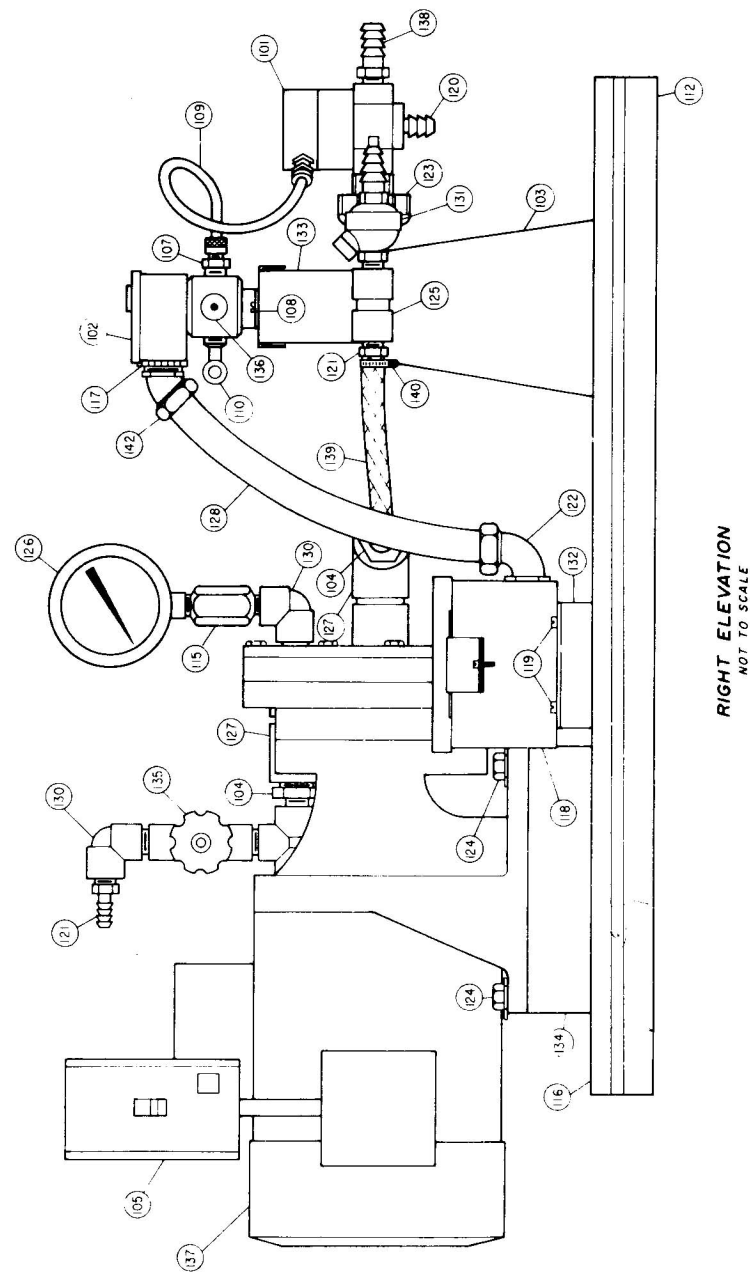
UNITED STATES
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BUREAU OF RECLAMATION
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
TITLE I DIVISION-DESALTING COMPLEX UNIT-ARIZONA
YUMA DESALTING PLANT
PLUGGING FACTOR MONITOR
SAMPLE POINT SELECTOR BOOSTER PUMP
PLAN-FRONT ELEVATION

DESIGNED BY *R. S. Carter* TECHNICAL APPROVAL *L. A. Hargrett*
DRAWN BY *R. S. Carter* SUBMITTED BY *L. A. Hargrett*
CHECKED BY *R. S. Carter* APPROVED BY *L. A. Hargrett*
CHIEF, APPLIED SCIENCES BRANCH

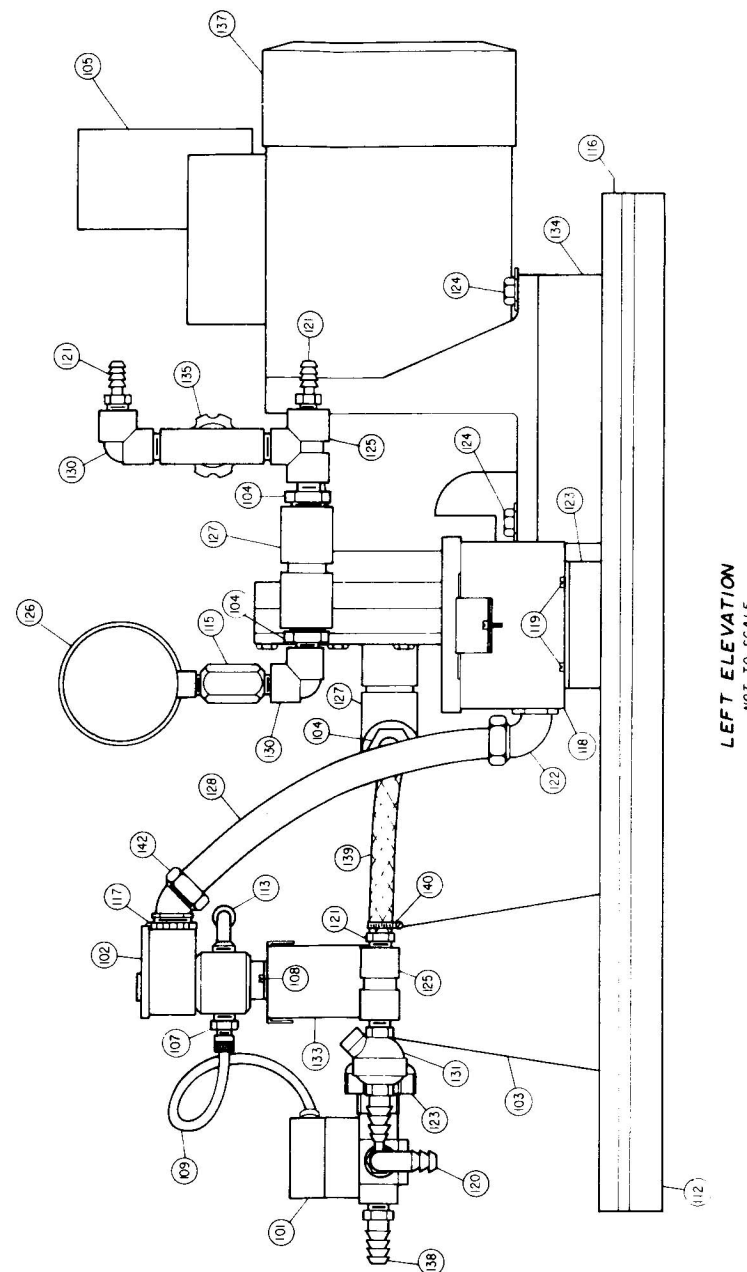
DENVER, COLORADO

FEB. 8, 1983

1292-D-4588



RIGHT ELEVATION
NOT TO SCALE



LEFT ELEVATION
NOT TO SCALE

NOTE
For general notes and reference drawings see Dwg. 1292-D-4582.

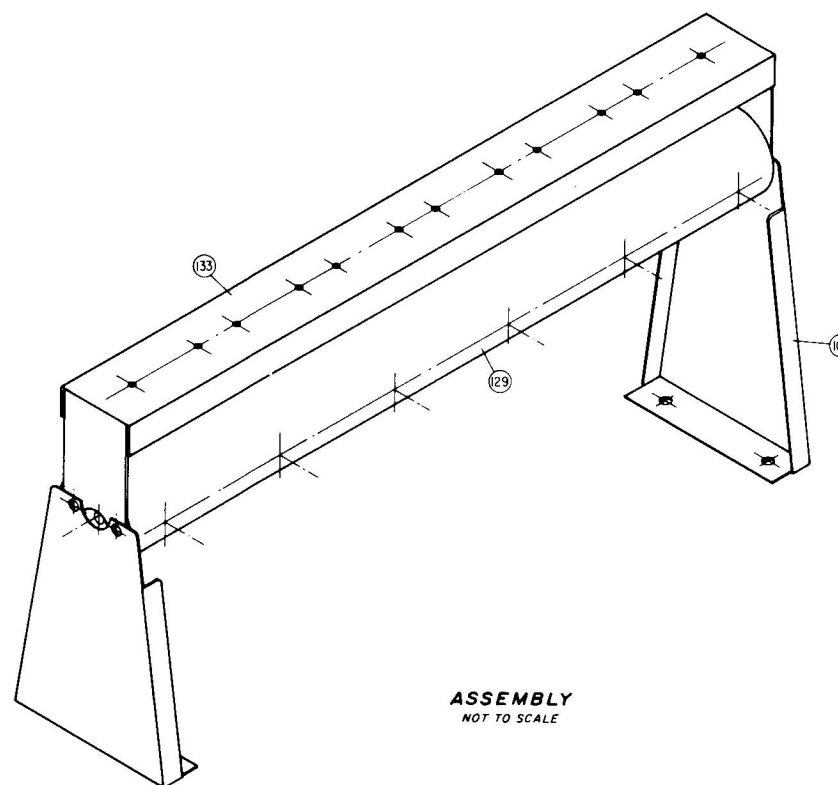
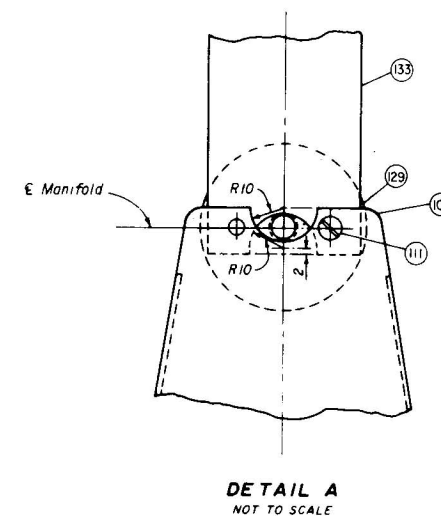
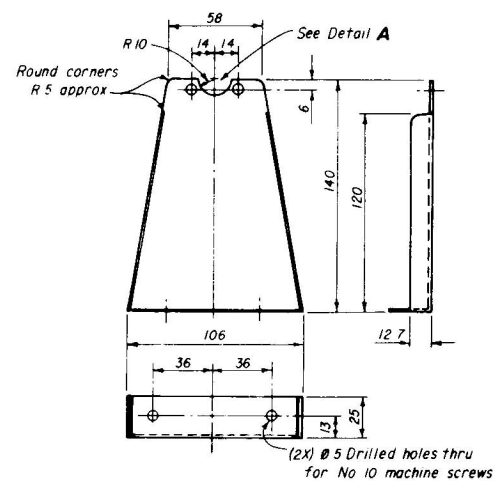
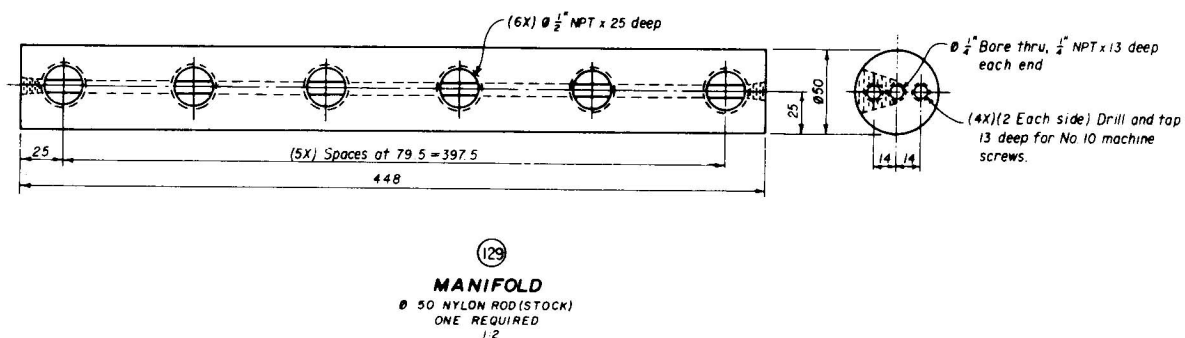
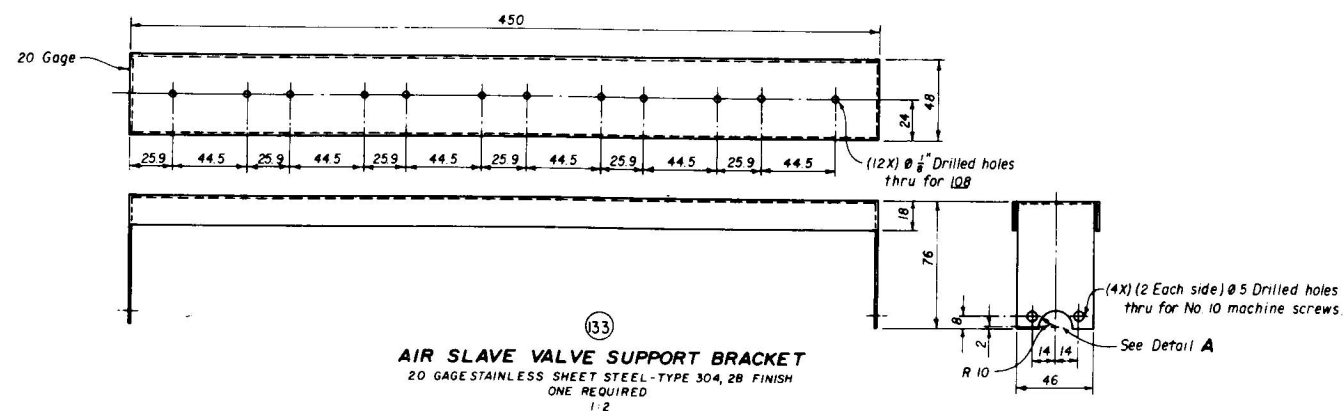
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UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION - DESALTING COMPLEX UNIT - ARIZONA YUMA DESALTING PLANT PLUGGING FACTOR MONITOR SAMPLE POINT SELECTOR BOOSTER PUMP RIGHT ELEVATION-LEFT ELEVATION	
DESIGNED <i>R. J. Seabolt</i>	TECHNICAL APPROVAL <i>J. B. Hargrett</i>
DRAWN <i>R. J. Seabolt</i>	SUBMITTED <i>R. J. Seabolt</i>
CHECKED <i>R. J. Seabolt</i>	APPROVED <i>J. B. Hargrett</i>
CHIEF, APPLIED SCIENCES BRANCH	
DENVER, COLORADO	FEB 8, 1983
1292-D-4589	

LIST OF PARTS

PART NO.	DRAWING NO.	NO. REQ'D.	DESCRIPTION	MATERIAL
101	No Detail	6	Sample Point Flow Valves; A, B, C, D, E and F. Three-way pneumatic valve, 1/4" orifice, 1/4" NPT, Model NV3-144-HP, Fluorocarbon Co. or equal.	Teflon
102	No Detail	6	Air Slave Valves; A, B, C, D, E and F. Three-way solenoid valve, 120 volt, normally closed operation, 1/4" pipe size, 3/32" orifice, CV flow factor equal to ASCO Red Hat, Catalog No. 832083 or equal.	Stainless Steel 303
103	1292-D-4591	2	Sample Point Valve Support Bracket	Stainless Sheet Steel 304
104	No Detail	10	1/2"-1/4" Bushing	PVC or Polypropylene
105	"	1	On-Off Motor Switch with heater reset and neon indicating light	
106	"	1	1/4" x 1/8" Poly-Flo Male Connector, No. 268-P 04 x 02 or equal	Brass
107	"	6	1/4" x 1/4" Poly-Flo Male Connector, No. 268-P 04 x 04 or equal	Brass
108	"	6	1/8" Sheet metal screw	Stainless Steel 316
109	"	As Req'd	1/4" Tubing. Poly-Flo Tubing, Imperial-Eastman, 44-P-1/4 or equal	Polypropylene
110	"	5	1/4" x 1/4" Tee. Poly-Flo Tee, No. 272-P 04 x 04 or equal	Brass
111	"	8	No. 10-24 UNC x 3/8" Long slotted fillister head machine screw with washer	Stainless Steel 316
112	1292-D-4592	2	Leg. ST 2" x 1.26"	Aluminum 6061-T6
113	No Detail	1	1/4" x 1/4" Poly-Flo Male Elbow, No. 269-P 04 x 04 or equal	Brass
114	"	20	1/4" Schedule 40 close nipples	PVC
115	"	1	1/4" FNPT x 1/4" MNPT Pulsation dampener	Stainless Steel 430
116	1292-D-4592	1	Base	Aluminum 6061-T6
117	No Detail	12	3/8" Rigid conduit fitting, bonding type locknut, Appleton BL 38 or equal	
118	"	2	Hoffman Enclosure, Box No. A-404LP, Type SC, waterproof for high voltage or equal	Steel
119	"	8	No. 10-24 UNC x 1" Long slotted fillister head machine screw with washer	Stainless Steel 316
120	"	6	1/4" MIPT x 3/8" Hose adaptor elbow	Polyethylene
121	"	6	1/4" MIPT x 5/16" Hose adaptor	Polyethylene
122	"	6	3/8" Rigid conduit connectors, 90° angle, Appleton ST 9038 or equal	
123	"	6	1/4" NPT Pipe union	PVC
124	"	4	3/8"-16 UNC x 2 1/2" Long hex head bolt with washer	Stainless Steel
125	"	3	1/4" Schedule 40 pipe tee	PVC
126	"	1	Pressure Gauge, 2 1/4" face, 1/4" BTM connection, SS-316 tube, 0-250 kPa	
127	"	2	1/2" Schedule 40 pipe tee	PVC
128	"	As Req'd	3/8" Flexible Liquid Tight Conduit, Type E.F.	
129	1292-D-4591	1	Sample Water Inlet Manifold	Nylon
130	No Detail	2	1/4" Schedule 40, 90° pipe elbow	PVC
131	"	2	Hose x Thread Chemcock Valve, Chemtrol .25 H x T or equal	PVC
132	1292-D-4592	4	Connector Box Support	Aluminum 6061-T6
133	1292-D-4591	1	Air Slave Valve Support	Stainless Sheet Steel 304
134	1292-D-4592	2	Pump Support	Aluminum 6061-T6
135	No Detail	1	1/4" Air Bleed Valve, needle valve, Chemtrol or equal	PVC
136	"	6	1/4" MNPT x 1/16" F Tube straight fitting, ASCO Catalog No. 6090-064 or equal	Brass
137	"	1	Sample Water Booster Pump, multistage centrifugal pump, 2 gpm at 86 feet, 4 gpm at 82 feet, 6 gpm at 72 feet, 3450 rpm, 3/4 hp, 120 volts, TEFC, Eastern Two Stage Centrifugal Pump, Model 2F-340 with 3 1/8" diameter impellers (2) or equal	
138	"	6	1/4" MIPT x 1/2" Hose adapter	Polyethylene
139	"	As Req'd	Inside diameter 5/16" flexible plastic tubing	Reinforced Vinyl
140	"	4	ADP Screw clamp	Stainless Steel
141	"	As Req'd	16/3 Type 50 Conductor Cord with oil resistant covering, provided with 3-prong 115 volt plug	
142	"	6	3/8" Rigid conduit connectors, 45° angle, Appleton ST 9038 or equal	

NOTE
For general notes and reference drawings see Dwg. 1292-D-4588.

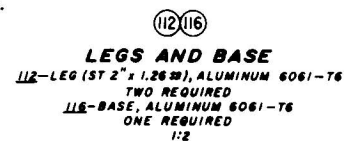
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UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION - DESALTING COMPLEX UNIT - ARIZONA YUMA DESALTING PLANT PLUGGING FACTOR MONITOR SAMPLE POINT SELECTOR BOOSTER PUMP LIST OF PARTS	
DESIGNED <i>R. J. ...</i>	TECHNICAL APPROVAL <i>J. A. ...</i>
DRAWN <i>R. J. ...</i>	SUBMITTED <i>J. A. ...</i>
CHECKED <i>R. J. ...</i>	APPROVED <i>J. A. ...</i>
DENVER, COLORADO FEB 8, 1963 1292-D-4590	



NOTE
For general notes and reference drawings see Dwg. 1292-D-4588.



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UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION-DESALTING COMPLEX UNIT-ARIZONA YUMA DESALTING PLANT PLUGGING FACTOR MONITOR SAMPLE POINT SELECTOR BOOSTER PUMP BRACKETS-MANIFOLD-DETAIL-ASSEMBLY	
DESIGNED <i>R. J. H. H.</i>	TECHNICAL APPROVAL <i>J. L. H. H.</i>
DRAWN <i>R. J. H. H.</i>	SUBMITTED <i>J. L. H. H.</i>
CHECKED <i>R. J. H. H.</i>	APPROVED <i>J. L. H. H.</i>
CHIEF, APPLIED SCIENCES BRANCH	
DENVER, COLORADO	FEB. 8, 1983
1292-D-4591	



Drill holes with legs (112) clamped in placed on base (116).

NOTES

* Dimensions are nominal and should match equipment provided.

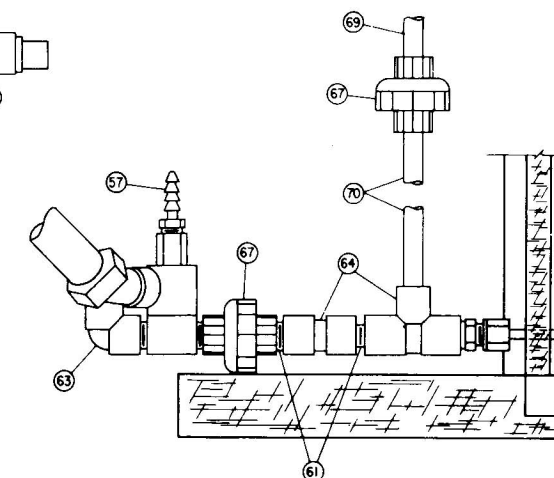
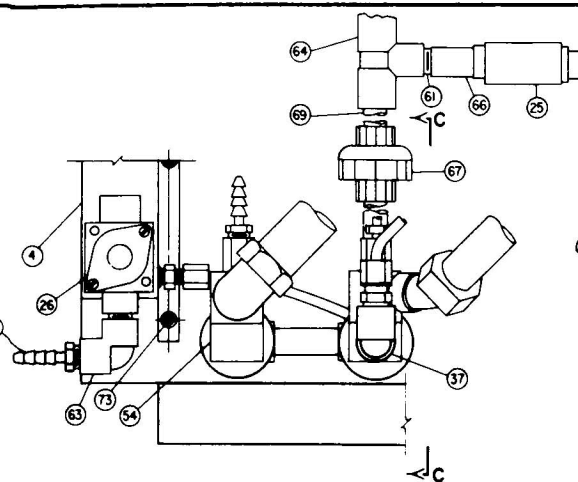
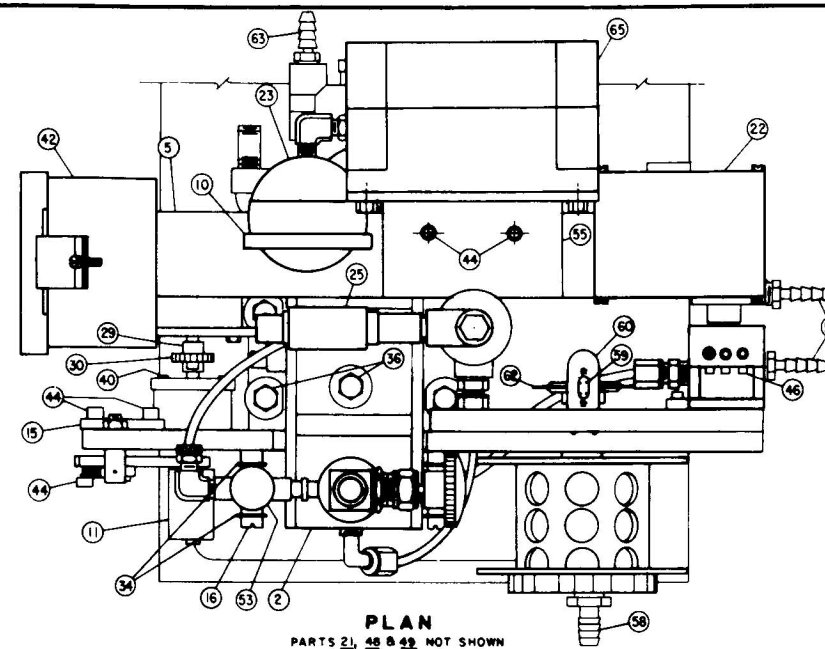
Figure 1 consists of two horizontal number lines. The top number line is labeled '10' at the left end and '50' at the right end. It has 11 tick marks, with the first tick mark at 10 and the last at 50. Below the line, the ratio '1:1' is indicated. The bottom number line is labeled '50' at the left end and '100' at the right end. It has 11 tick marks, with the first tick mark at 50 and the last at 100. Below the line, the ratio '1:2' is indicated.

ALWAYS THINK SAFETY

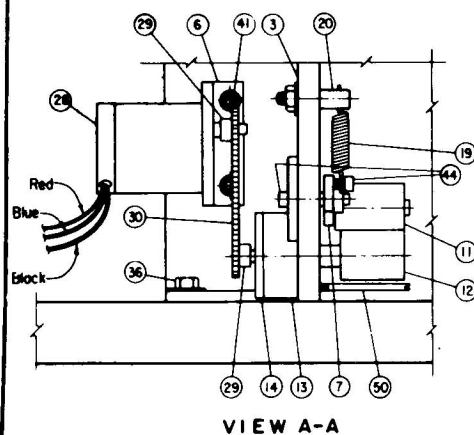
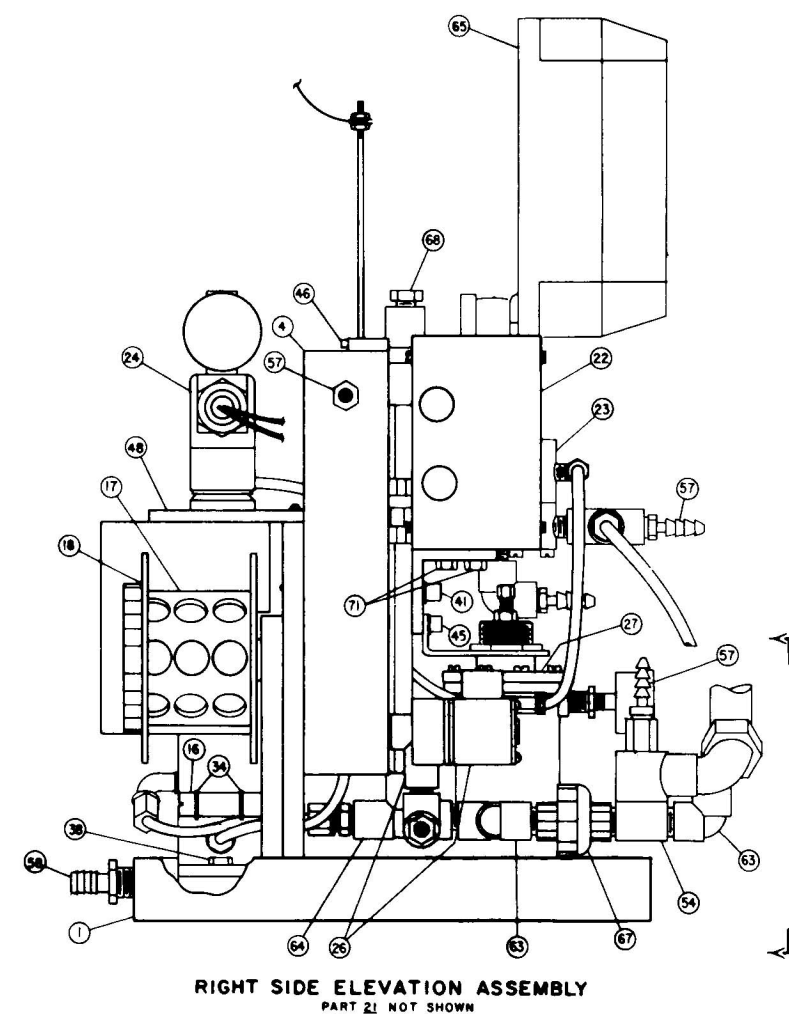
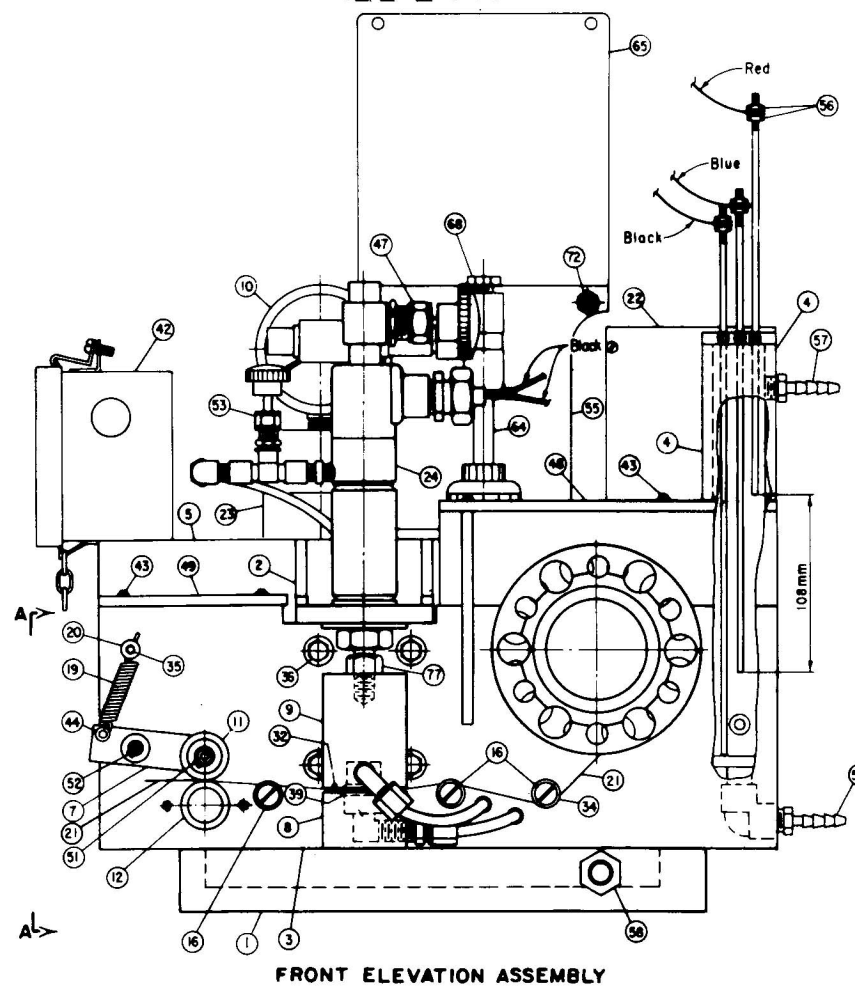
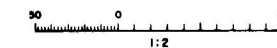
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
TITLE 1 DIVISION-DESALTING COMPLEX UNIT- ARIZONA
YUMA DESALTING PLANT
PLUGGING FACTOR MONITOR
SAMPLE POINT SELECTOR BOOSTER PUMP
LEGS AND BASE-SUPPORTS-DETAIL

DESIGNED BY R. S. Baker TECHNICAL APPROVAL J. D. Hayslett
DRAWN A. N. K. Rine SUBMITTED T. E. Gault
CHECKED BY R. S. Baker APPROVED J. D. Hayslett
CHIEF, APPLIED SCIENCES BRANCH

DENVER, COLORADO FEB. 8, 1963 1292-D-4592



NOTES
All process tubing to be 1/4" O.D., either nylon or polypropylene.
All process pipe and fittings, 1/4" NPT, PVC.
All process transitions, 1/4" NPT pipe to 1/4" threaded tube,
PVC or nylon.
All air line tubing to be suitable material.
For general notes and reference drawings see Dwg. 1292-D-4595.
For additional assembly views see Dwg. 1292-D-4596 and
1292-D-4599.



ALWAYS THINK SAFETY	
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION	
COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION-DESALTING COMPLEX UNIT- ARIZONA	
YUMA DESALTING PLANT	
PLUGGING FACTOR MONITOR	
TESTER	
PLAN-ELEVATIONS-SECTIONS	
DESIGNED <i>R. J. Smith</i>	TECHNICAL APPROVAL <i>J. L. Huggins</i>
DRAWN <i>R. J. Smith</i>	SUBMITTED <i>R. J. Smith</i>
CHECKED <i>R. J. Smith</i>	APPROVED <i>R. J. Smith</i>
CHIEF, APPLIED SCIENCE BRANCH	
DENVER, COLORADO	FEB. 8, 1983
1292-D-4593	

LIST OF PARTS

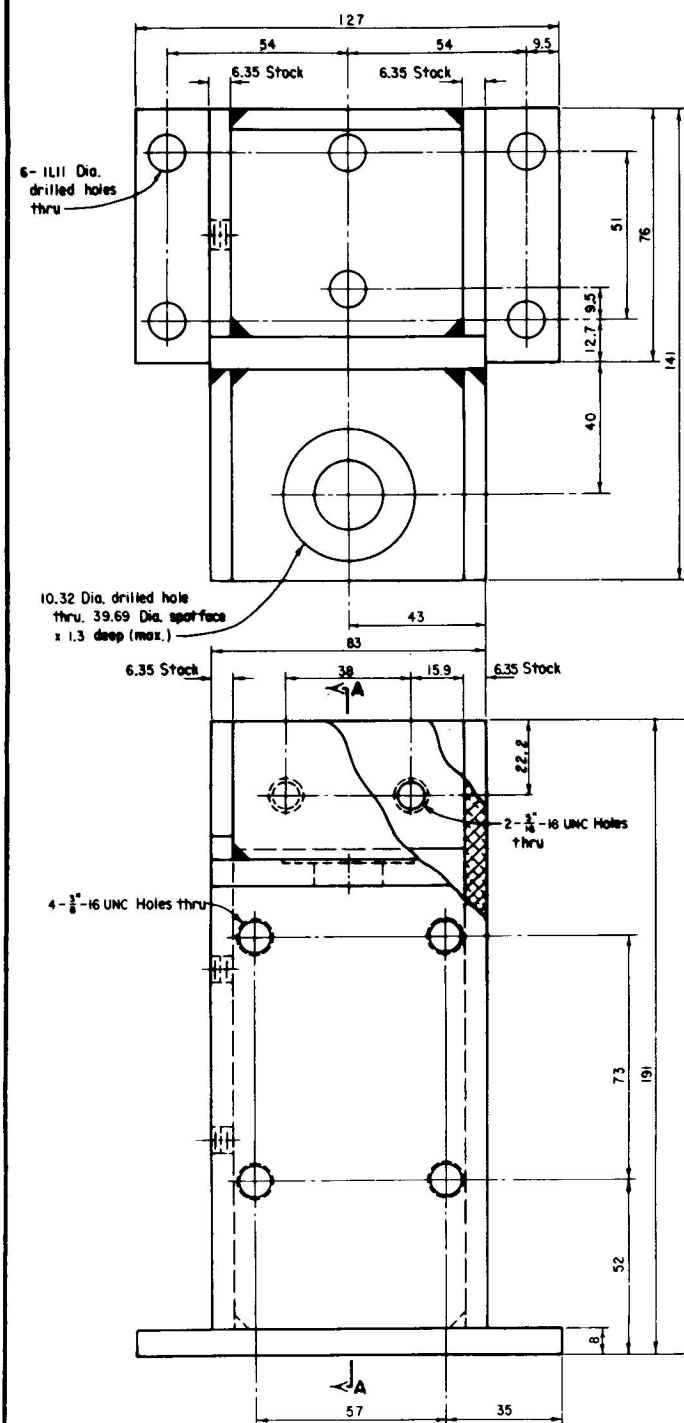
PART NO.	NO. REQ'D.	DESCRIPTION	MATERIAL
1	1	Major Base (-4595)	Nylon
2	1	Rest for Air Cylinder (-4595)	Aluminum 6061-T6
3	1	Support Plate (-4596)	Acrylic Resin
4	1	MT (Measuring Tank) (-4597)	
5	1	Horizontal Support Bracket (-4597)	Aluminum 6061-T6
6	1	Motor Bracket (-4597)	
7	1	Tension Roll Arm (-4598)	SS 304
8	1	LFH (Lower Filter Head) (-4597)	Acrylic Resin
9	1	UFH (Upper Filter Head) (-4597)	
10	1	Pressure Gauge, bourden tube, 2 1/2" face, 1/4" BTM conn., 0 to 250 kPa	Brass Tube
11	1	Tension Roll (-4598)	SS 303
12	1	Drive Roll (-4598)	SS 304
13	1	Bearing Housing (-4598)	Aluminum 6061-T6
14	1	Bearing Cover (-4598)	
15	1	Tension Pivot (-4598)	SS 304
16	3	Guide Pin (-4598)	Nylon
17	1	FMT (Filter Membrane Tape) Holder (-4599)	Aluminum 6061-T6
18	1	FMT Holder Collar (-4599)	
19	1	Spring (by fabricator)	SS
20	1	Spring Adjuster (-4598)	SS 304
21	1	FMT 1" Wide x 100' long, 0.45 microns, Millipore Corporation, Catalog No. E865-A7 wound on 3" x 1 1/4" wide PVC pipe (-4599)	Manufacturer's Spec.
22	1	Mechanical Card Enclosure J-2, waterproof, 4" x 3" x 5"	Steel
23	1	UFH Balance Back Pressure Regulator, equal to Grove Mity-Mite model 591LW, 172-2760 kPa (25-400 psi) or equal	SS 316
24	1	Air Cylinder, built-in 3-way solenoid - 115V AC, equal to Bimbo model 171-NRSC or equal	Brass or Steel
25	1	Bell & Howell CEC 1000 sputtered Gauge Pressure Transducers, 0-345 kPa (0-50 psig)	SS17-7
26	1	MT Drain Valve, 2-way solenoid-115V, normally open, C _v = 0.42, 1/4" NPT, Valcor Cat. No. 52C19M14-8 or equal	Polypropylene
27	1	Air Regulator, 0-400 kPa, 1/4" NPT (in and out) with pressure gauge, 0-400 kPa, Conoflow FM-60XT or equal	Brass or Steel
28	1	FMT Drive Motor, equal to Bodine gear motor, model 724, type KCL, frame 22-T4 or equal	—
29	2	Gear Pulley, equal to Pic. Cat. No. FC5-32, 32 pitch, 1" pitch chain, 32 teeth, 3/16" foil or equal	SS
30	1	Positive Drive Belt, equal to Pic. Cat. No. FA-95, 32 pitch x 95 drive pins or equal	—
31	2	Sealed Ball Antifriction Bearing, .3937" bore x 1.1811" O.D. x .3543" wide with locknut and lockwasher	SS
32	1	UFH O-ring Seal, 7/8" I.D. x 1" O.D. x 0.070" thick	Buna-N
33	1	Probe Holder (-4597)	Acrylic Resin
34	6	Guide Pin Slip-on O-ring	Vitar
35	1	No. 10-32 UNF x 1/4" Long socket type set screw	
36	10	3/8"-16 UNC x 1" Long hex. hd. machine screw with washer	SS 316
37	1	UFH Feed Water Diverter Valve, 3-way solenoid - 120 V, Brunswick Technetics, normally closed, 1/4" NPT ports, direct acting, Cat. No. 83126	
38	2	1/4"-20 UNC x 3/4" Long hex. hd. cap screw with washer	Nylon
39	1	Screen, machined from Millipore Swinnex, 25 filter holder No. SX00-025-00, Millipore Corp or equal	Plastic
40	2	No. 10-32 UNF x 1 1/2" Long socket hd. cap screw with washer	SS

LIST OF PARTS CONTINUED

PART NO.	NO. REQ'D.	DESCRIPTION	MATERIAL
41	4	5/16" x 18 UNC x 3/4" Long socket hd. cap screw with washer	SS
42	1	Terminal Box J-1, for solenoid valves, waterproof	Steel
43	4	No. 10-32 UNF x 1/2" Long round hd. machine screw	
44	5	1/4"-20 UNC x 3/4" Long socket hd. cap screw with washer	SS
45	2	1/4"-20 UNC x 1/2" Long socket hd. cap screw with washer	
46	3	No. 6-32 UNC x 1/4" Long socket hd. cap screw	Nylon
47	1	Air Cylinder Bleed Valve, 1/4" NPT, Whitey B-1KF4 or equal	Brass
48	1	Right Shield (-4596)	Acrylic Resin
49	1	Left Shield (-4596)	
50	3	Probes, 1/8" x 240 mm long, 1/8" x 290 mm long, 1/8" x 330 mm long. #5-40 UNC x 25 mm Thread length on one end	SS 316
51	1	Retaining Ring equal to Walde Truarc No. 5100-37	Steel
52	1	Retaining Ring equal to Walde Truarc No. 5100-25	
53	1	Needle Valve, 1/8" NPT, Whitey B-ORF2 or equal	Brass
54	1	UFH Feed Water Diverter Valve, 2-way solenoid - 120 V, Brunswick Technetics, normally closed, 1/4" NPT ports, direct acting, Cat. No. B2224	SS 316
55	1	Signal Transmitter Support Bracket (-4599)	Aluminum 6061-T6
56	6	Probe Lead Nuts. No. 5-40 UNC with washer	SS
57	6	Pipe to Hose Adapter, 1/4" NPT x 5/16" O.D. Hose End	Polypropylene
58	1	Pipe to Hose Adapter, 1/2" NPT x 1/2" nipple	
59	1	OPFS (Optical Paper Fault Sensor) equal to Monsanto model MC-T2E	—
60	1	Bracket for OPFS (-4599)	—
61	11	1/4" Schedule 80 Close Nipple	PVC
62	1	Tape Advance Counting Wheel (-4599)	Aluminum 6061-T6
63	5	1/4" Schedule 40, 90° Elbow	PVC
64	4	1/4" Schedule 40 Tee	
65	1	Signal Conditioning Transmitter equal to Bell & Howell Type 1-375, excitation 110V, output 4-20 mA into 500 ohms load, linearity ±0.5% output span, temperature range 10°C to 50°C or equal	—
66	1	Pipe to Transducer Adapter, 1/4" NPT to 7/16"-20 female	Plastic
67	3	1/4" Schedule 40 Union	
68	1	1/4" Schedule 40 Plug	PVC
69	2	1/4" x 2" Schedule 40 Nipple	
70	1	1/4" x 8" Schedule 40 Nipple	
71	4	1/4"-20 UNC x 2" Long hex. head bolt with washer	
72	2	1/4"-20 UNC x 1" Long socket head cap screw with nut	SS
73	2	No. 10-32 UNC x 1" Long socket head cap screw with washer	
74	1	Tank and Right Shield Bracket (-4596)	Acrylic Resin
75	1	FAFNIR #202 NPP Bearing or equal	Steel
76	1	1/2"-20 UNF Nut	SS
77	1	7/16"-20 UNF Nut	
78	As Req'd	1/4" Outside diameter tube fittings, 1725 kPa (250 psi), Nylo-Seal Flareless Tube Fittings or equal	Thermoplastic and Polypropylene
79	"	1/4" Outside diameter tube fittings, 1725 kPa (250 psi), Poly-Flo Flareless Tube Fittings or equal	Brass and Polypropylene

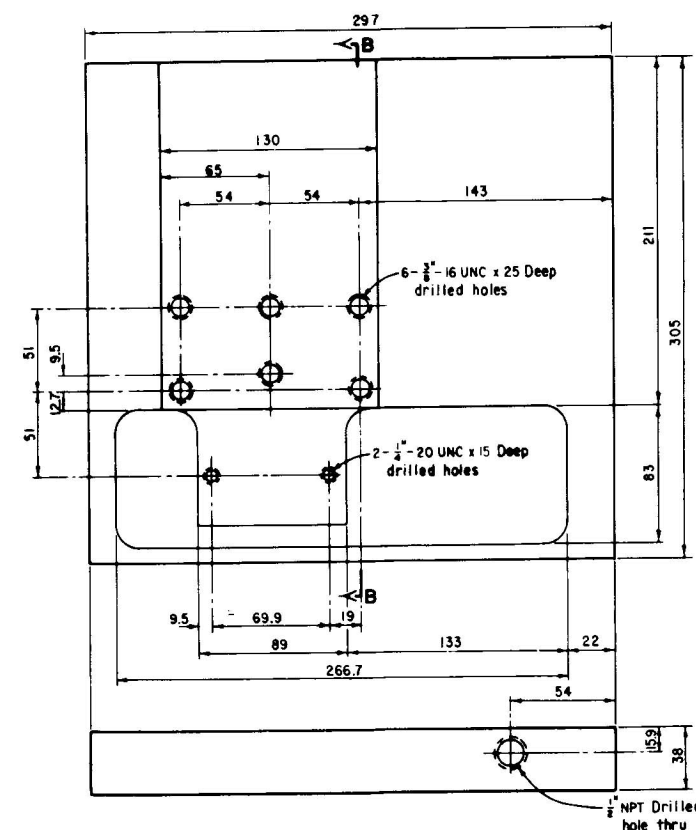
NOTE
For general notes and reference drawings see Dwg. I292-D-4595.

ALWAYS THINK SAFETY	
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE 1 DIVISION-DESALTING COMPLEX UNIT-ARIZONA	
YUMA DESALTING PLANT PLUGGING FACTOR MONITOR TESTER LIST OF PARTS	
DESIGNED: <i>D. J. Schaefer</i>	TECHNICAL APPROVAL: <i>J. A. Hengstler</i>
DRAWN: <i>A. J. Lee</i>	SUBMITTED: <i>J. S. Beckley</i>
CHECKED: <i>C. J. Schaefer</i>	APPROVED: <i>J. A. Hengstler</i>
CHIEF, APPLIED SCIENCES BRANCH	
DENVER, COLORADO	FEB. 8, 1983
I292-D-4594	



①
REST FOR AIR CYLINDER
ALUMINUM 6061-T6
1:1

SECTION A-A



②
MAJOR BASE
NYLON
1:1

SECTION B-B

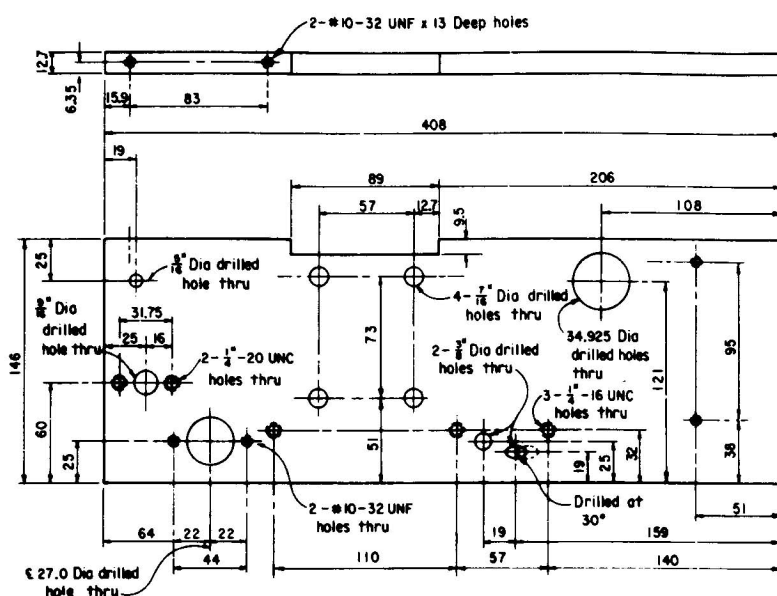
GENERAL NOTES

Break all sharp edges and corners.
250 Type finish all over except where noted otherwise.
Machine surfaces unless otherwise specified (U.O.S.)
① Within 0.002 T.I.R.
② Within 0.0005 per inch
③ Within 0.001 per inch
Dimensions are in millimeters unless otherwise shown.
For finished overall dimensions see the specifications paragraphs.
Part numbers are denoted as (78) and are identified on Dwg. 1292-D-4594.

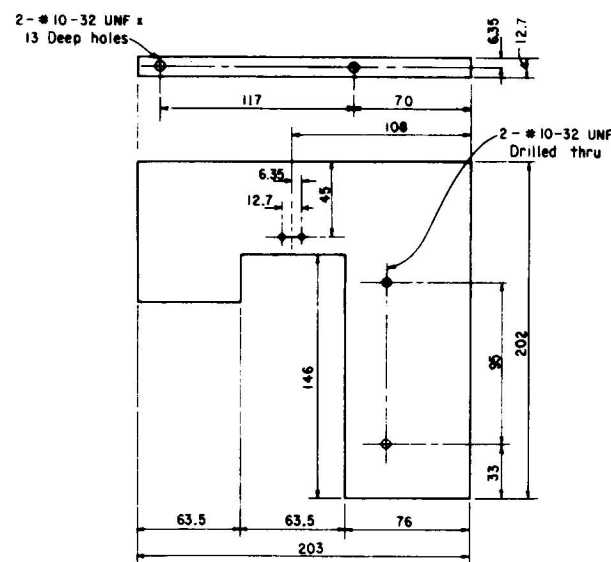
REFERENCE DRAWINGS

SAMPLE POINT SELECTOR BOOSTER PUMP -
PLAN - FRONT ELEVATION 1292-D-4588
SCHEMATIC DIAGRAMS 1292-D-4587
HARDWARE OVERVIEW 1292-D-4600

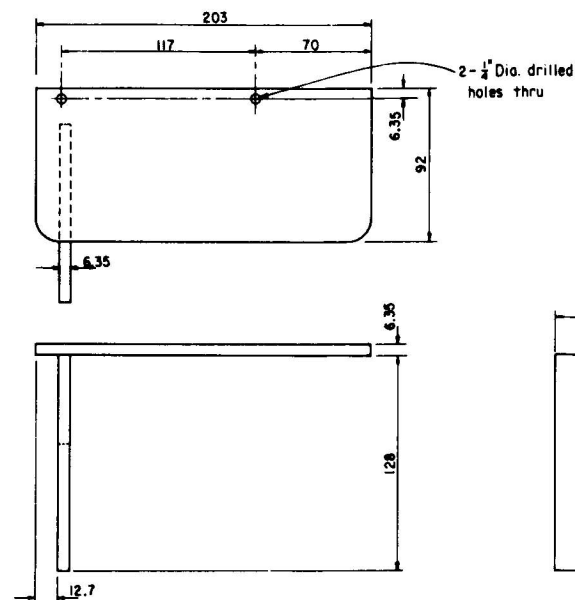
SAFETY	
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION-DESALTING COMPLEX UNIT-ARIZONA	
YUMA DESALTING PLANT PLUGGING FACTOR MONITOR REST FOR AIR CYLINDER-MAJOR BASE	
DESIGNED: <i>R. J. Smith</i>	TECHNICAL APPROVAL: <i>J. D. Thompson</i>
DRAWN: <i>A. J. Smith</i>	SUBMITTED: <i>J. D. Thompson</i>
CHECKED: <i>R. J. Smith</i>	APPROVED: <i>J. D. Thompson</i>
CHIEF, APPLIED SCIENCES BRANCH	
DENVER, COLORADO	FEB. 8, 1983
1292-D-4595	



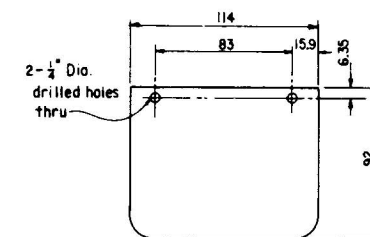
3
VERTICAL SUPPORT PLATE
12.7 THICK ACRYLIC RESIN
1:2



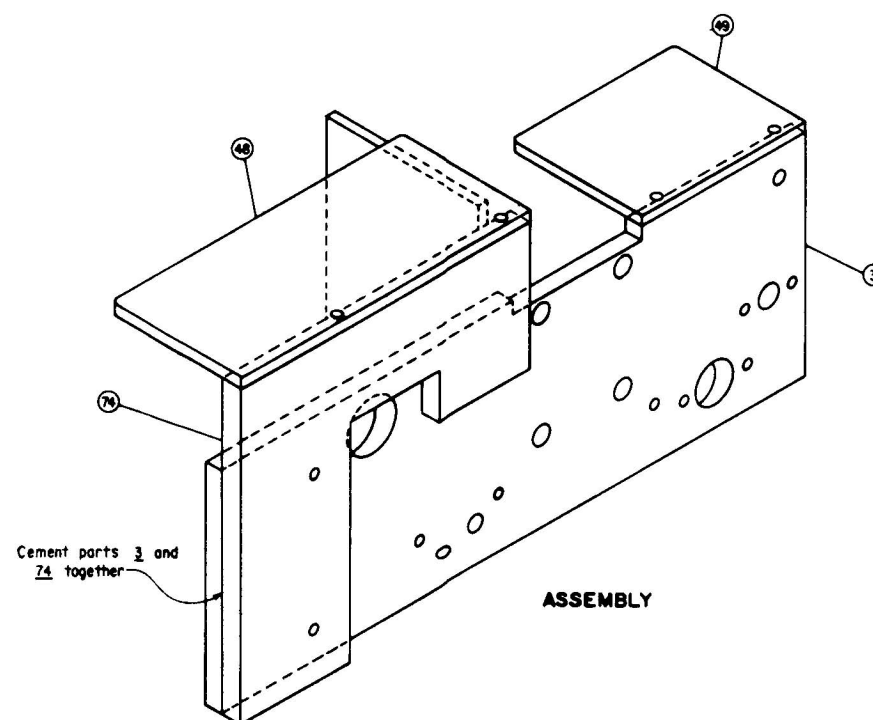
74
TANK AND RIGHT SHIELD BRACKET
12.7 THICK ACRYLIC RESIN
1:2



48
RIGHT SHIELD
6.35 THICK ACRYLIC RESIN
1:2



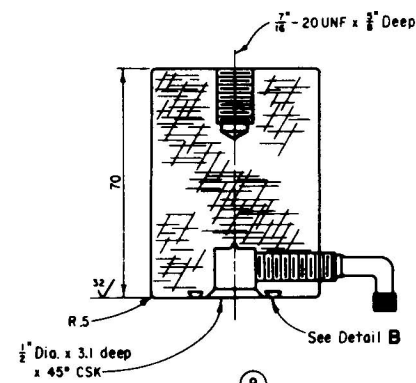
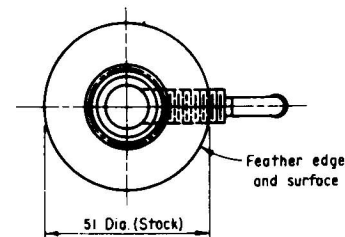
49
LEFT SHIELD
6.35 THICK ACRYLIC RESIN
1:2



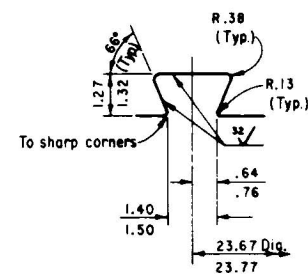
NOTE
For general notes and reference drawings see Dwg. 1292-D-4595.

<p>ALWAYS THINK SAFETY</p> <p>UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION - DESALTING COMPLEX UNIT - ARIZONA YUMA DESALTING PLANT PLUGGING FACTOR MONITOR TESTER ASSEMBLY - DETAILS</p>	
DESIGNED <i>[Signature]</i>	TECHNICAL APPROVAL <i>[Signature]</i>
DRAWN <i>[Signature]</i>	SUBMITTED <i>[Signature]</i>
CHECKED <i>[Signature]</i>	APPROVED <i>[Signature]</i>
<p>DENVER, COLORADO FEB. 8, 1983</p>	

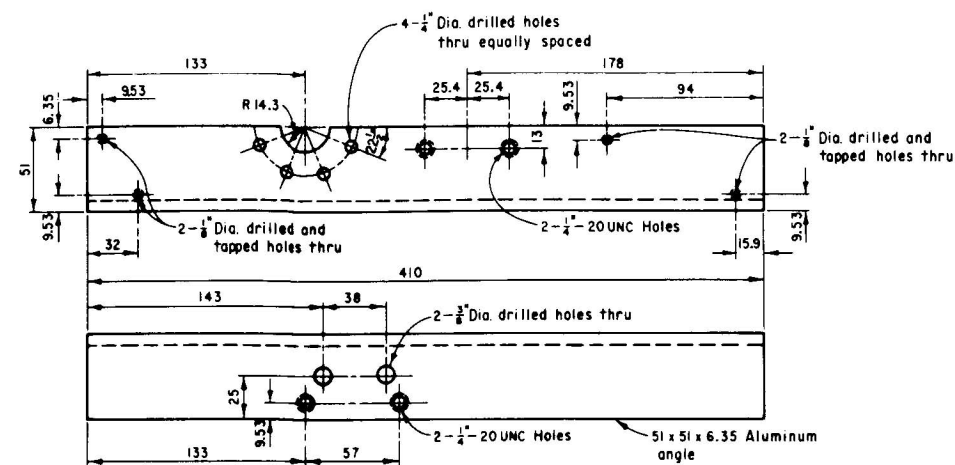
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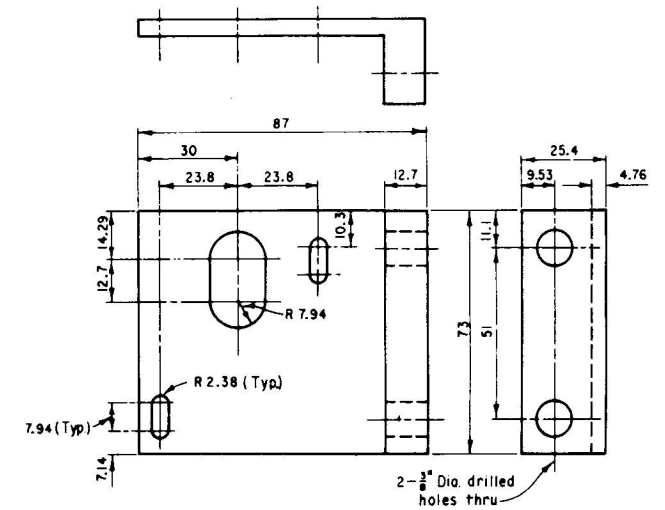
UPPER FILTER HEAD
ACRYLIC RESIN
1:1



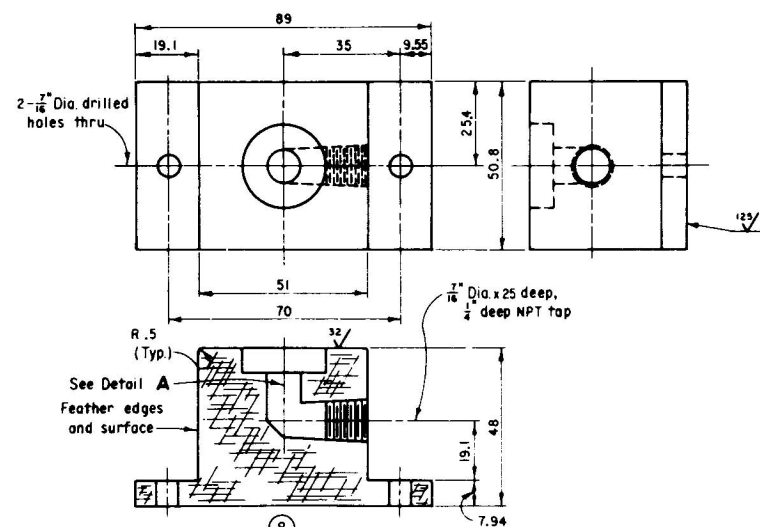
DETAIL B
GROOVE DETAIL



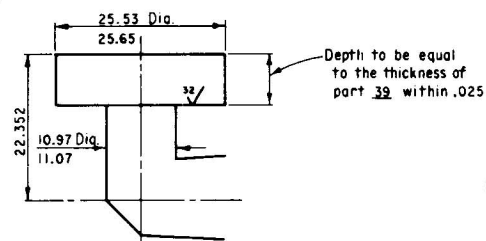
HORIZONTAL SUPPORT BRACKET
ALUMINUM 6061-T6
1:2



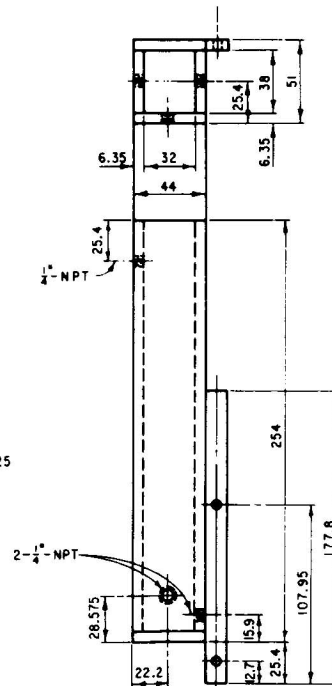
MOTOR BRACKET
ALUMINUM 6061-T6
1:2



LOWER FILTER HEAD
ACRYLIC RESIN
1:1

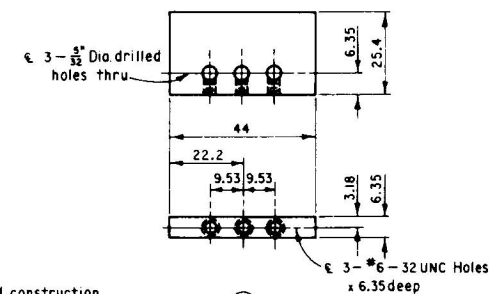


DETAIL A



MEASURING TANK
.25" THICK ACRYLIC RESIN
1:2

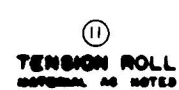
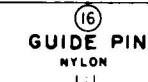
NOTE: All glued construction joints to be watertight. Do not cement tank to part 75.



PROBE HOLDER
.25" THICK ACRYLIC RESIN
1:2

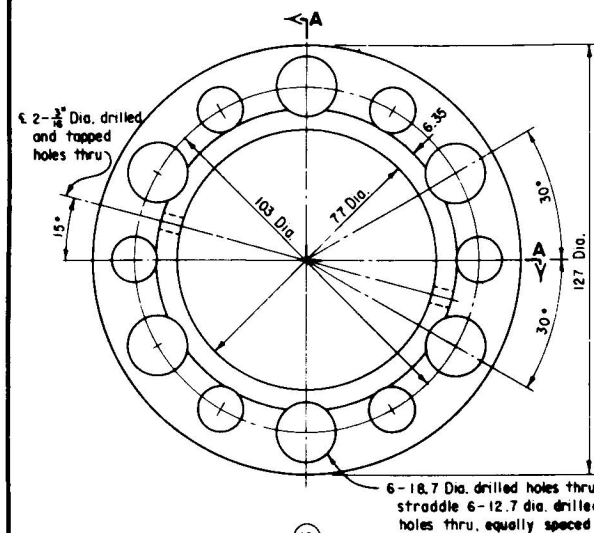
NOTE
For general notes and reference drawings see Dwg. 1292-D-4595.

SAFETY	
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION-DESALTING COMPLEX UNIT-ARIZONA	
YUMA DESALTING PLANT PLUGGING FACTOR MONITOR TESTER DETAILS	
DESIGNED <i>P. J. Smith</i>	TECHNICAL APPROVAL <i>J. A. Hargrett</i>
DRAWN <i>P. J. Smith</i>	SUBMITTED <i>J. A. Hargrett</i>
CHECKED <i>P. J. Smith</i>	APPROVED <i>J. A. Hargrett</i>
CHIEF, APPLIED SCIENCES BRANCH	
DENVER, COLORADO	FEB 8, 1963
1292-D-4597	

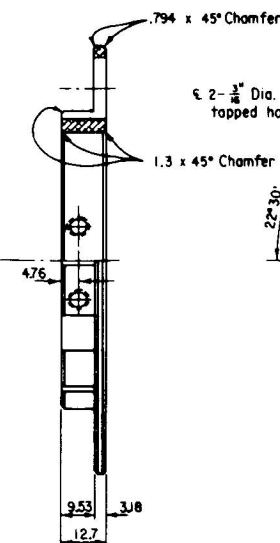


$\frac{3}{8}$ " O.D. x $\frac{1}{2}$ " I.D. x $\frac{1}{2}$ " Lg.
 Bost - bronze bearing
 (7) Boston Gear Cat. No. B46-4
TENSION ROLL ARM
 SS 304
 1:1

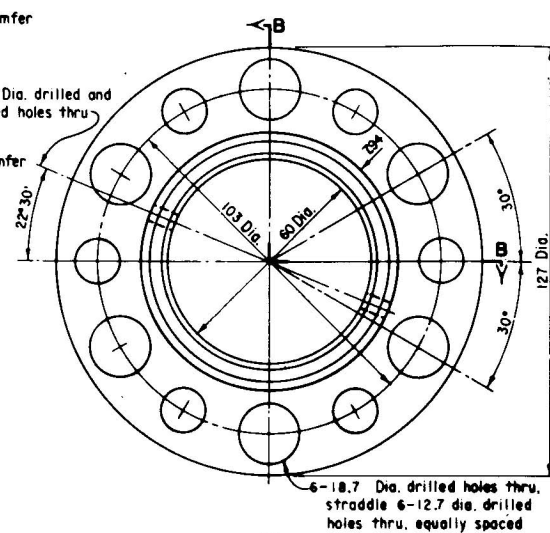
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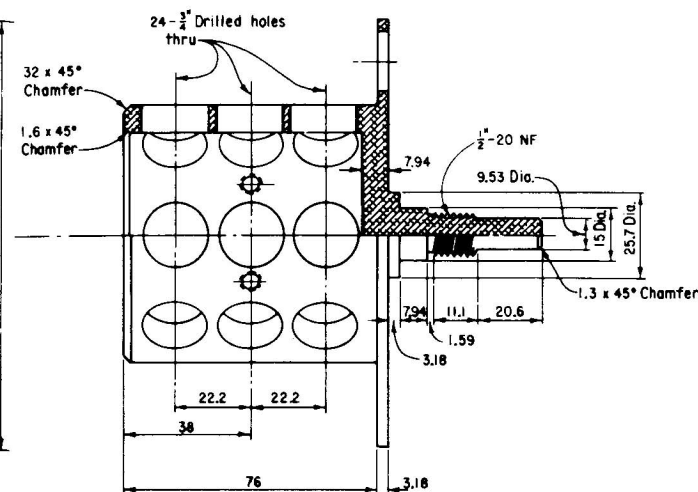
18
FILTER MEMBRANE TAPE HOLDER COLLAR
ALUMINUM 6061-T6 (MACHINE FROM ROUND STOCK)
1:1



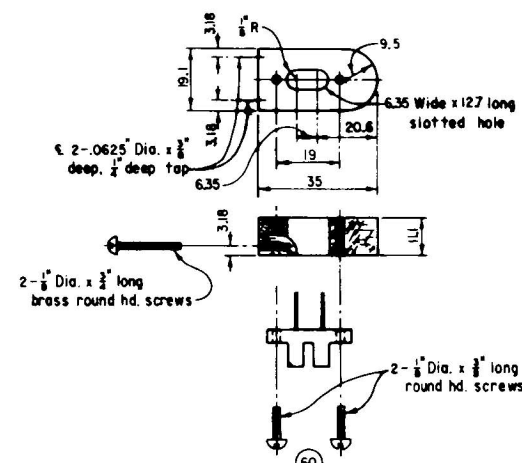
SECTION A-A



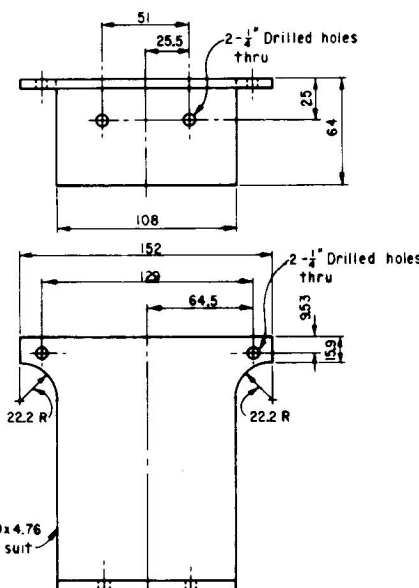
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FILTER MEMBRANE TAPE HOLDER
ALUMINUM 6061-T6 (MACHINE FROM ROUND STOCK)
1:1



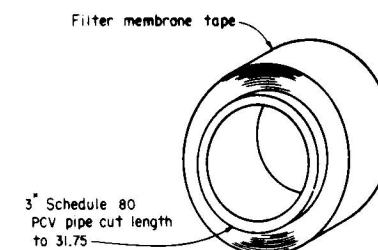
SECTION B-B



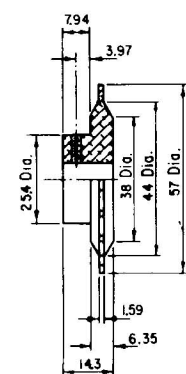
60
BRACKET FOR OPTICAL PAPER FAULT SENSOR
1:1



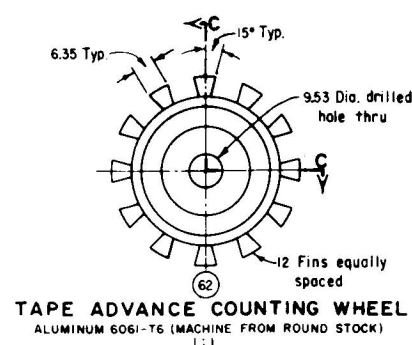
55
SIGNAL TRANSMITTER SUPPORT BRACKET
ALUMINUM 6061-T6
1:1



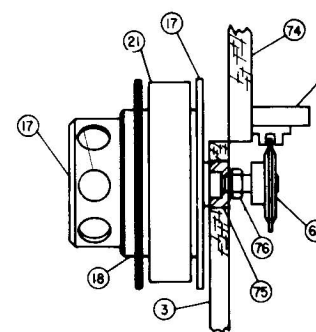
21
FILTER MEMBRANE TAPE
1:2



SECTION C-C



62
TAPE ADVANCE COUNTING WHEEL
ALUMINUM 6061-T6 (MACHINE FROM ROUND STOCK)
1:1



ASSEMBLY

NOTE
For general notes and reference drawings see Dwg. 1292-D-4595.

ALWAYS THINK SAFETY	
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION COLORADO RIVER BASIN SALINITY CONTROL PROJECT TITLE I DIVISION-DESALTING COMPLEX UNIT-ARIZONA	
YUMA DESALTING PLANT PLUGGING FACTOR MONITOR TESTER	
ASSEMBLY-DETAILS-SECTIONS	
DESIGNED <i>[Signature]</i>	TECHNICAL APPROVAL <i>[Signature]</i>
DRAWN <i>[Signature]</i>	SUBMITTED <i>[Signature]</i>
CHECKED <i>[Signature]</i>	APPROVED <i>[Signature]</i>
CHIEF, APPLIED SCIENCE BRANCH	
DENVER, COLORADO	FEB 8, 1983
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Mission of the Bureau of Reclamation

The Bureau of Reclamation of the U.S. Department of the Interior is responsible for the development and conservation of the Nation's water resources in the Western United States.

The Bureau's original purpose "to provide for the reclamation of arid and semiarid lands in the West" today covers a wide range of interrelated functions. These include providing municipal and industrial water supplies; hydroelectric power generation; irrigation water for agriculture; water quality improvement; flood control; river navigation; river regulation and control; fish and wildlife enhancement; outdoor recreation; and research on water-related design, construction, materials, atmospheric management, and wind and solar power.

Bureau programs most frequently are the result of close cooperation with the U.S. Congress, other Federal agencies, States, local governments, academic institutions, water-user organizations, and other concerned groups.

A free pamphlet is available from the Bureau entitled "Publications for Sale." It describes some of the technical publications currently available, their cost, and how to order them. The pamphlet can be obtained upon request from the Bureau of Reclamation, Attn D-922, P O Box 25007, Denver Federal Center, Denver CO 80225-0007.